Advanced Macroeconomics

Vertiefung Makroökonomik

Univ.-Prof. Dr. Robert L. Czudaj

TU Bergakademie Freiberg

Winter Semester 2025/26

Contents

Some Issues in Macroeconomics

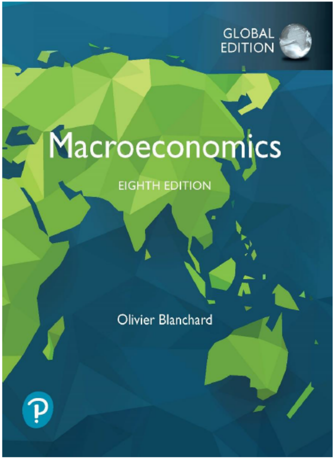
- What determines output/production? Depends on the horizon:
  - Short run
  - Medium run
  - Long run
- Can monetary and/or fiscal policy prevent a recession? What are the effects of interest rate cuts, tax cuts or increases in government spending?
- Why may a financial crisis lead to a recession?
- How does inflation occur and how is it prevented?

The Short Run, the Medium Run, and the Long Run

- In the **short run** (e.g., a few years), year-to-year movements in output are primarily driven by movements in demand.
- In the **medium run** (e.g., a decade), the economy tends to return to the level of output determined by supply factors, such as the capital stock, the level of technology, and the size of the labor force.
- In the **long run** (e.g., a few decades or more), the economy depends on its ability to innovate and introduce new technologies, and how much people save, the quality of the country's education system, the quality of the government, and so on.

Macroeconomics

Eighth Edition, Global Edition



Pearson

THE CORE

PART I: INTRODUCTION

1. A Tour of the World
2. A Tour of the Book

PART II: THE SHORT RUN

3. The Goods Market
4. Financial Markets I
5. Goods and Financial Markets; The IS-LM Model
6. Financial Markets II

PART III: THE MEDIUM RUN

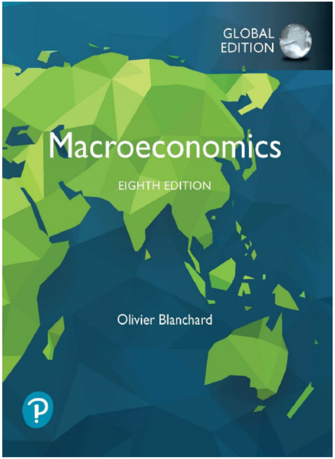
7. The Labor Market
8. The Phillips Curve, the Natural Rate of Unemployment, and Inflation
9. Putting All Markets Together: From the Short to the Medium Run

PART IV: THE LONG RUN

10. The Facts of Growth
11. Saving, Capital Accumulation, and Output
12. Technological Progress and Growth
13. The Challenges of Growth

Macroeconomics

Eighth Edition, Global Edition



Pearson

EXTENSIONS

PART V: EXPECTATIONS

14. Financial Markets and Expectations
15. Expectations, Consumption, and Investment
16. Expectations, Output, and Policy

PART VI: THE OPEN ECONOMY

17. Openness in Goods and Financial Markets
18. The Goods Market in an Open Economy
19. Output, the Interest Rate, and the Exchange Rate
20. Exchange Rate Regimes

PART VII: BACK TO POLICY

21. Should Policy Makers Be Restrained?
22. Fiscal Policy: A Summing Up
23. Monetary Policy: A Summing Up
24. Epilogue: The Story of Macroeconomics

German Version

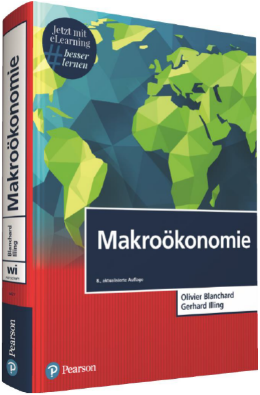
Olivier Blanchard, Gerhard Illing

Makroökonomie

8., aktualisierte Auflage
ISBN: 978-3-86894-427-3
832 Seiten | 2-farbig
€ 54,95 [D] | € 54,95 [A] | sFr 62,20*

www.pearson.de
www.pearson.ch

Pearson

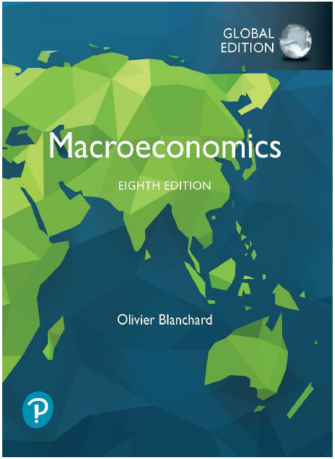


Copyright © 2021 Pearson Education Ltd.

Contents

Macroeconomics

Eighth Edition, Global Edition



Pearson

Chapters 3 - 6

The Short Run

The *IS*-*LM* Model

Outline

The Short Run

The Goods Market

- When economists think about year-to-year movements in economic activity, they focus on the interactions among *demand*, *production*, and *income*:
  - Changes in the *demand for goods* lead to changes in *production*.
  - Changes in *production* lead to changes in *income*.
  - Changes in *income* lead to changes in the *demand for goods*.

3.1 The Composition of GDP (1 of 3)

- **Consumption** (C): goods and services purchased by consumers
- **Investment** (I): the sum of nonresidential investment and residential investment
- **Government spending** (G): purchases of goods and services by the federal, state, and local governments; excluding **government transfers**

3.1 The Composition of GDP (2 of 3)

- **U.S. perspective:** U.S. is the domestic economy
- **Exports** (X): purchases of U.S. goods and services by foreigners
- **Imports** (IM): purchases of foreign goods and services by U.S. consumers, U.S. firms and the U.S. government
- **Net exports** or **trade balance**: $X - IM$
- Exports $>$ Imports $\Leftrightarrow$ trade surplus
- Exports $<$ Imports $\Leftrightarrow$ trade deficit
- Inventory investment: difference between production and sales

3.1 The Composition of GDP (3 of 3)

Table 3.1 The Composition of U.S. GDP, 2018

		Billions of Dollars	Percent of GDP
	GDP (Y)	20,500	100.0
1	Consumption (C)	13,951	68.0
2	Investment (I)	3,595	17.5
	Nonresidential	2,800	13.6
	Residential	795	3.8
3	Government spending (G)	3,522	17.2
4	Net exports	−625	−3.0
	Exports (X)	2,550	12.4
	Imports (IM)	−3,156	−15.4
5	Inventory investment	56	0.2

Source: Survey of Current Business, February 2019, Table 1-1-5

3.2 The Demand for Goods (1 of 7)

$$Z \equiv C + I + G + X - IM$$

- The above identity defines the **total demand for goods** (Z) as consumption, plus investment, plus government spending, plus exports, minus imports.
- In a **closed economy** ($X = IM = 0$):

$$Z \equiv C + I + G$$

3.2 The Demand for Goods (2 of 7)

- Consumption (C) is a function of **disposable income** (Y_D), which is the income that remains once consumers have received government transfers and paid their taxes.

$$C = C(\underset{(+)}{Y_D}) \tag{2.1}$$

- $C(Y_D)$ is called the **consumption function**.
- This is a **behavioral equation** that captures the behavior of consumers.

3.2 The Demand for Goods (3 of 7)

- Assume that the consumption function is a **linear relation** with two **parameters**, c_0 and c_1:

$$C = c_0 + c_1 Y_D \tag{2.2}$$

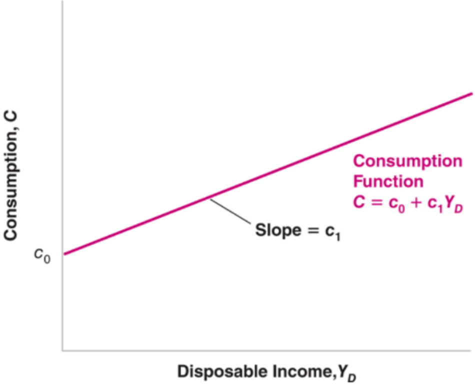
- c_1 is the **propensity to consume**.
- c_0 is what people would consume if their disposable income equals zero.
- Changes in c_0 reflect changes in consumption for a given level of disposable income.

3.2 The Demand for Goods (4 of 7)

Figure 3.1 Consumption and Disposable Income

Consumption increases with disposable income but less than one for one.

A lower value of c_0 will shift the entire line down.



3.2 The Demand for Goods (5 of 7)

- Disposable income is:

$$Y_D \equiv Y - T$$

where Y is income and T is taxes minus government transfers.

- Replacing Y_D in Eq. (2.2) gives:

$$C = c_0 + c_1(Y - T) \tag{2.3}$$

3.2 The Demand for Goods (6 of 7)

- **Endogenous variables**: variables depend on other variables in the model
- **Exogenous variables**: variables not explained within the model but are instead taken as given

$$I = \bar{I} \tag{2.4}$$

- A bar on investment means investment is taken as given.

3.2 The Demand for Goods (7 of 7)

- T and G describe **fiscal policy** – the choice of taxes and spending by the government.
- G and T are exogenous because:
  - Governments do not behave with the same regularity as consumers or firms.
  - We are trying to assess the effect of changing G and T by the government on output within the model.

3.3 The Determination of Equilibrium Output (1 of 10)

- Assume $X = IM = 0$, so

$$Z \equiv C + I + G$$

- Replacing C and I from Eqs. (2.3) and (2.4):

$$Z = c_0 + c_1(Y - T) + \bar{I} + G \tag{2.5}$$

- **Equilibrium in the goods market** requires

$$Y = Z \tag{2.6}$$

- This is an **equilibrium condition**.

3.3 The Determination of Equilibrium Output (2 of 10)

- Replacing Z in Eq. (2.6) by Eq. (2.5) gives

$$Y = c_0 + c_1(Y - T) + \bar{I} + G \tag{2.7}$$

- *In equilibrium, production (Y) is equal to demand, which in turn depends on income (Y), which is itself equal to production.*

- Rewrite Eq. (2.7):

$$Y = c_0 + c_1 Y - c_1 T + \bar{I} + G$$

- Reorganize the equation:

$$(1 - c_1) Y = c_0 + \bar{I} + G - c_1 T$$

- Divide both sides by $(1 - c_1)$:

$$Y = \underbrace{\frac{1}{1 - c_1}}_{\text{Multiplier}} \underbrace{\left[c_0 + \bar{I} + G - c_1 T\right]}_{\text{Autonomous spending}} \tag{2.8}$$

which characterizes equilibrium output in algebra.

3.3 The Determination of Equilibrium Output (4 of 10)

- **Autonomous spending**: $[c_0 + \bar{I} + G - c_1 T]$
- Autonomous spending is positive because if $T = G$ (**balanced budget**) and c_1 is between 0 and 1, then $(G - c_1 T)$ is positive, and so is autonomous spending.
- The term $1/(1 - c_1)$ is the **multiplier**, which is larger when c_1 is closer to 1.
- If c_1 equals 0.6, the multiplier equals $1/(1 - 0.6) = 2.5$, meaning that an increase of consumption by \$1 billion will increase output by 2.5 x \$1 billion = \$2.5 billion.

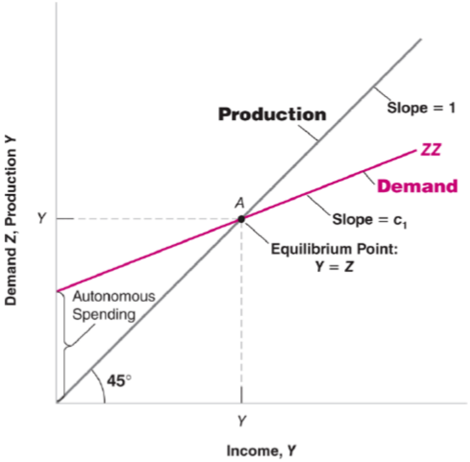
- Steps to characterize the equilibrium graphically:
  1. Plot production as a function of income. Because production equals income, their relation is the 45-degree line.
  2. Plot demand as a function of income.

$$Z = (c_0 + \bar{I} + G - c_1 T) + c_1 Y \tag{2.9}$$

  3. In equilibrium, production equals demand.

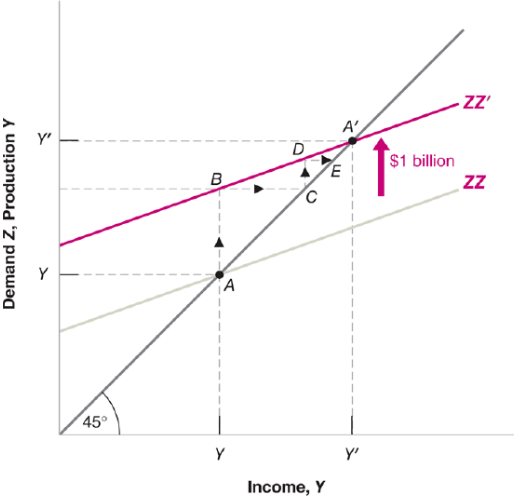
Figure 3.2 Equilibrium in the Goods Market

Equilibrium output is determined by the condition that production is equal to demand.



- Suppose c_0 increases by \$1 billion.

Figure 3.3 The effects of an increase in autonomous spending on output
An increase in autonomous spending has a more than one-for-one effect on equilibrium output.



3.3 The Determination of Equilibrium Output (8 of 10)

- AB: first-round increase in production
- BC: first-round increase in income
- CD: second-round increase in demand
- DE: second-round increase in production and income
- The total increase in production after $n+1$ rounds:

$$1 + c_1 + c_1^2 + \ldots + c_1^n$$

- which is a **geometric series** with a limit of $1/(1-c_1)$.

3.3 The Determination of Equilibrium Output (9 of 10)

- To summarize our findings using words:
  - Production depends on demand, which depends on income, which is itself equal to production.
  - An increase in demand leads to an increase in production and income, which in turn leads to a future increase in demand.
  - The increase in output is larger than the initial shift in demand, by a factor equal to the multiplier.
  - The multiplier depends on the propensity to consume, which can be estimated using **econometrics** – the set of statistical methods used in economics.

3.3 The Determination of Equilibrium Output (10 of 10)

- The adjustment of output over time is called the **dynamics** of adjustment.
- How long the adjustment takes depends on how and when firms revise their production schedule.

3.4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium (1 of 5)

- John Maynard Keynes articulated an alternative model that focuses instead on investment and saving in the *General Theory of Employment, Interest and Money* in 1936.
- **Private saving** (S) is

$$S \equiv Y_D - C$$

$$S \equiv Y - T - C$$

- By definition, **public saving** $= T - G$.
- Public saving $> 0 \Leftrightarrow$ **Budget surplus**
- Public saving $< 0 \Leftrightarrow$ **Budget deficit**

3.4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium (2 of 5)

- In equilibrium:

$$Y = C + I + G$$

- Subtract T from both sides and move C to the left side:

$$Y - T - C = I + G - T$$

- The left side of the equation is simply S, so

$$S = I + G - T$$

- Or equivalently

$$I = S + (T - G) \tag{2.10}$$

- This is the ***IS* relation**, which stands for "**I**nvestment equals **S**aving".

3.4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium (3 of 5)

- Two equivalent ways of stating the **condition for equilibrium** in the goods market:

$$\begin{aligned} \text{Production} &= \text{Demand} \\ \text{Investment} &= \text{Saving} \end{aligned}$$

3.4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium (4 of 5)

- We can also derive Eq. (2.8) using Eq. (2.10).
- Because consumption behavior implies that

$$\begin{aligned} S &= Y - T - C \\ &= Y - T - c_0 - c_1(Y - T) \end{aligned}$$

- Rearranging terms, so

$$S = -c_0 + (1 - c_1)(Y - T) \tag{2.11}$$

- $(1 - c_1)$ is called the **propensity to save**, which is between zero and one.

3.4 Investment Equals Saving: An Alternative Way of Thinking about Goods-Market Equilibrium (5 of 5)

- In equilibrium, $I = S$, so that Eq. (2.10) becomes:

$$I = -c_0 + (1 - c_1)(Y - T) + (T - G)$$

- Solve for output:

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T] \tag{2.12}$$

which is the same as Eq. (2.8).

Financial Markets

- Financial markets play an essential role in the economy.
- We now focus on the role of the **central bank** in affecting interest rates.
- We learn how the interest rate on bonds is determined, and the role of the central bank (Federal Reserve Bank, or the Fed, in the United States) in this determination.

4.1 The Demand for Money (1 of 3)

- Suppose you only have a choice between two assets: *money* and *bonds*.
- **Money** is used for transactions, but it pays no interest.
- Two types of money: **currency** and **checkable deposits**.
- **Bonds** pay a positive interest rate, i (the rate of interest), but cannot be used for transactions.
- The holding of money and bonds depends on:
  - Your level of transactions
  - The interest rate on bonds

4.1 The Demand for Money (2 of 3)

- Demand for money (M^d) is equal to nominal income $\$Y$ (a measure of level of transactions in the economy) times a decreasing function of the interest rate i:

$$M^d = \$Y \underset{(-)}{L(i)} \tag{2.13}$$

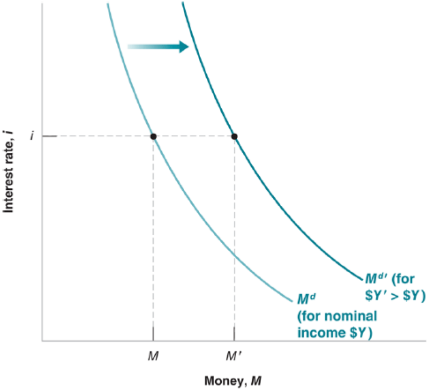
- An increase in the interest rate decreases the demand for money, as people put more of their wealth into bonds.
- Eq. (2.13) means that the demand for money:
  - increases in proportion to nominal income, and
  - depends negatively on the interest rate.
- The relation between the demand for money and the interest rate for a given level of income $\$Y$ is represented by the M^d curve.

4.1 The Demand for Money (3 of 3)

Figure 4.1 The Demand for Money

For a given level of nominal income, a lower interest rate increases the demand for money.

At a given interest rate, an increase in nominal income shifts the demand for money to the right.



4.2 Determining the Interest Rate (1 of 8)

- Suppose the central bank decides to supply an amount of money equal to M:

$$M^s = M$$

- Equilibrium in financial markets requires that $M^s = M^d = M$:

$$\begin{aligned} \text{Money supply} &= \text{Money demand} \\ M &= \$YL(i) \end{aligned} \tag{2.14}$$

4.2 Determining the Interest Rate (2 of 8)

Figure 4.2 The Determination of the Interest Rate

The interest rate must be such that the supply of money (which is independent of the interest rate) is equal to the demand for money (which does depend on the interest rate).

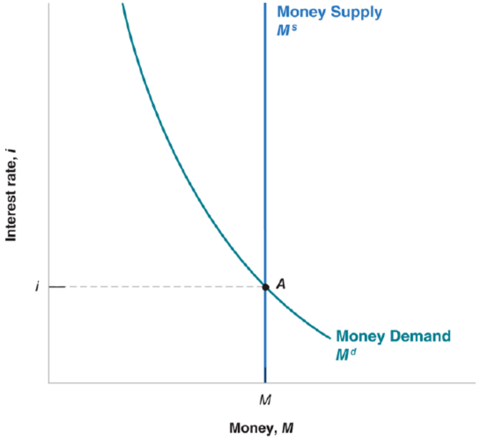
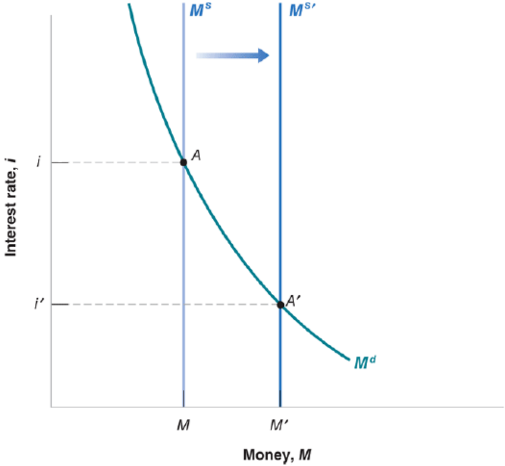


Figure 4.3 The Effects of an Increase in the Money Supply on the Interest Rate

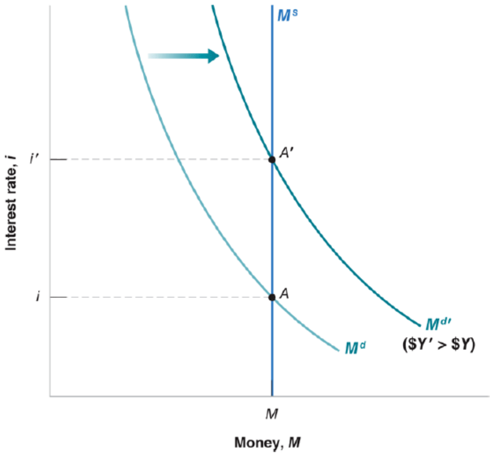
An increase in the supply of money leads to a decrease in the interest rate.



4.2 Determining the Interest Rate (4 of 8)

Figure 4.4 The Effects of an Increase in Nominal Income on the Interest Rate

Given the money supply, an increase in nominal income leads to an increase in the interest rate.



4.2 Determining the Interest Rate (5 of 8)

- For a given money supply, an increase in nominal income leads to an increase in the interest rate.
- An increase in the supply of money by the central bank leads to a decrease in the interest rate.

4.2 Determining the Interest Rate (6 of 8)

- Central banks typically change the supply of money by buying or selling bonds in the bond market through **open market operations**.
- **Expansionary open market operation**: the central bank expands the supply of money by buying bonds.
- **Contractionary open market operation**: the central bank contracts the supply of money by selling bonds.

4.2 Determining the Interest Rate (7 of 8)

- Suppose a bond such as a **Treasury bill**, or **T-bill**, promises to pay \$100 a year from now.
- If the price of the bond today is $\$P_B$, then the interest rate on the bond is:

$$i = \frac{\$100 - \$P_B}{\$P_B}$$

- *The higher the price of the bond, the lower the interest rate.*
- *The higher the interest rate, the lower the price today.*

4.2 Determining the Interest Rate (8 of 8)

- Rather than the money supply, the central bank could have chosen the interest rate and then adjusted the money supply so as to achieve the interest rate it had chosen.
- Choosing the interest rate, instead of the money supply, is what modern central banks, including the Fed, typically do.

4.4 The Liquidity Trap (1 of 2)

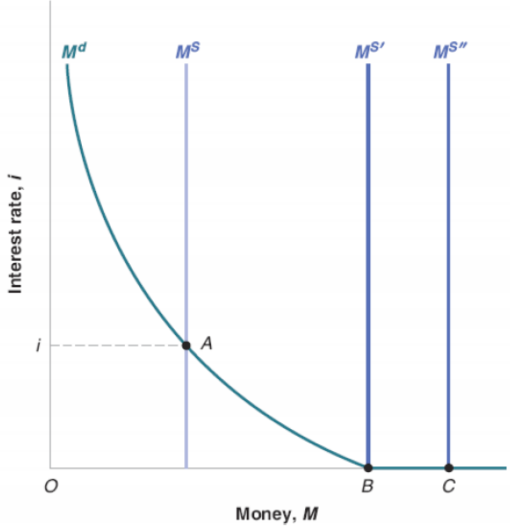
- **Zero lower bound**: The interest rate cannot go below zero.
- The economy is in a **liquidity trap** when the interest rate is down to zero, monetary policy cannot decrease it further.

4.4 The Liquidity Trap (2 of 2)

Figure 4.8 Money Demand, Money Supply, and the Liquidity Trap

When the interest rate is equal to zero, and once people have enough money for transaction purposes, they become indifferent between holding money and holding bonds. The demand for money becomes horizontal.

This implies that, when the interest rate is equal to zero, further increases in the money supply have no effect on the interest rate, which remains equal to zero.



Goods and Financial Markets: The *IS-LM* Model

- Chapter 3 looks at the goods market, and Chapter 4 at financial markets.
- Now we look at goods and financial markets together, and understand how output and the interest rate are determined in the short run.
- John Hicks and Alvin Hansen called this framework the *IS-LM* model.

5.1 The Goods Market and the *IS* Relation (1 of 6)

- In the model developed in Chapter 3, **investment** was assumed to be constant for simplicity.
- In fact, investment depends on production Y (or sales) and the interest rate i.

$$I = \underset{(+,-)}{I(Y, i)} \tag{2.15}$$

- So, equilibrium in the goods market becomes:

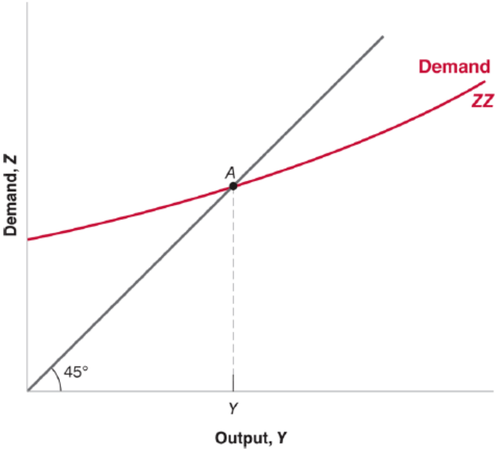
$$Y = C(Y - T) + I(Y, i) + G \tag{2.16}$$

which is the *IS* relation.

5.1 The Goods Market and the *IS* Relation (2 of 6)

Figure 5.1 Equilibrium in the Goods Market

The demand for goods is an increasing function of output. Equilibrium requires that the demand for goods be equal to output.



5.1 The Goods Market and the *IS* Relation (3 of 6)

- ZZ is **upward-sloping** because, for a given value of the interest rate, an increase in output leads to an increase in the demand for goods through its effects on consumption and investment.
- ZZ is **flatter** than the 45-degree line because we have assumed that an increase in output leads to a less than one-for-one increase in demand.
- The intersection of ZZ and the 45-degree line (point A) is the **equilibrium** level of output.

5.1 The Goods Market and the *IS* Relation (4 of 6)

Figure 5.2 The *IS* Curve

(*a*) An increase in the interest rate decreases the demand for goods at any level of output, leading to a decrease in the equilibrium level of output.

(*b*) Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.

The ***IS curve*** is therefore downward sloping.

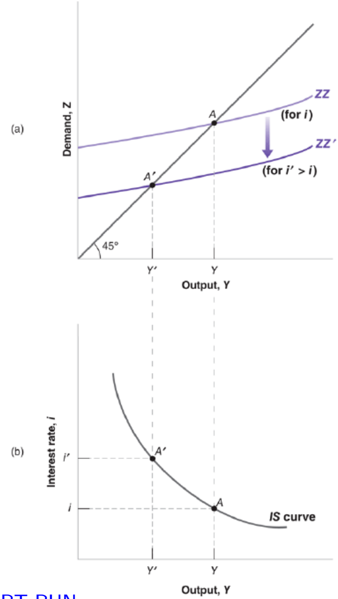
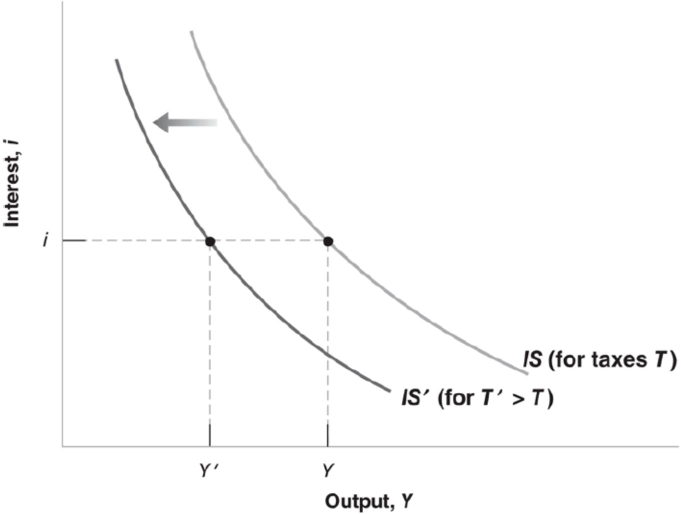


Figure 5.3 Shifts of the *IS* Curve

An increase in taxes shifts the *IS* curve to the left.



5.1 The Goods Market and the *IS* Relation (6 of 6)

- **Downward-sloping *IS* curve:** Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.
- **Shifting the *IS* curve:** Changes in factors that decrease (increase) the demand for goods given the interest rate shift the *IS* curve to the left (right).

5.2 Financial Markets and the *LM* Relation (1 of 3)

- Recall Chapter 4:

$$M = \$YL(i)$$

- Divide both sides of the equation by the **price level** P:

$$\frac{M}{P} = YL(i) \tag{2.17}$$

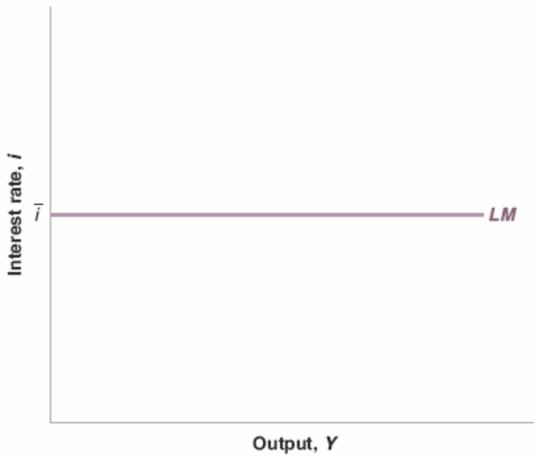
which is the LM relation.

- In equilibrium, real money supply equals the real money demand, which depends on real income Y, and the interest rate i.

5.2 Financial Markets and the *LM* Relation (2 of 3)

Figure 5.4 The *LM* Curve

The central bank chooses the interest rate (and adjusts the money supply so as to achieve it).



5.2 Financial Markets and the *LM* Relation (3 of 3)

- *IS* relation:

$$Y = C(Y - T) + I(Y, i) + G$$

- *LM* relation:

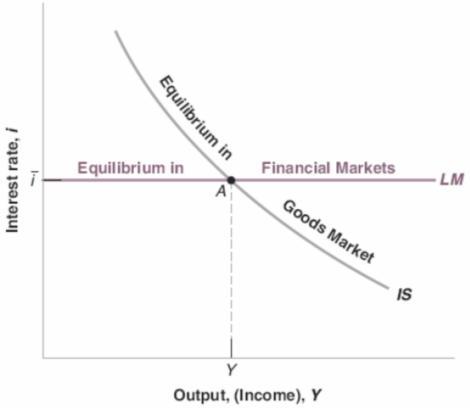
$$i = \bar{i}$$

- The *IS* and *LM* relations together determine output.
- Any point on the downward sloping *IS* curve corresponds to an equilibrium in the goods market.
- Any point on the horizontal *LM* curve corresponds to an equilibrium in financial markets.
- Only at their intersection (point *A*) are both equilibrium relations satisfied.

5.3 Putting the *IS* and the *LM* Relations Together (1 of 5)

Figure 5.5 The *IS*-*LM* Model

Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.
This is represented by the *IS* curve.
Equilibrium in financial markets is represented by the horizontal *LM* curve.
Only at point *A*, which is on both curves, are both goods and financial markets in equilibrium.



5.3 Putting the *IS* and the *LM* Relations Together (2 of 5)

- Fiscal Policy:

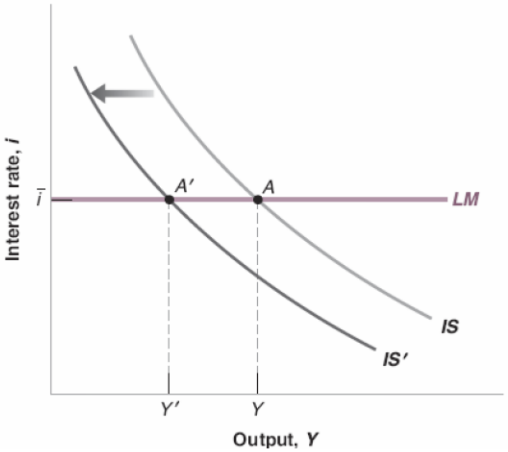
  Decrease in $G - T \Leftrightarrow$ **fiscal contraction** $\Leftrightarrow$ **fiscal consolidation**

  Increase in $G - T \Leftrightarrow$ **fiscal expansion**

5.3 Putting the *IS* and the *LM* Relations Together (3 of 5)

Figure 5.6 The Effects of an Increase in Taxes

An increase in taxes shifts the *IS* curve to the left. This leads to a decrease in the equilibrium level of output.



5.3 Putting the *IS* and the *LM* Relations Together (4 of 5)

- Monetary Policy:

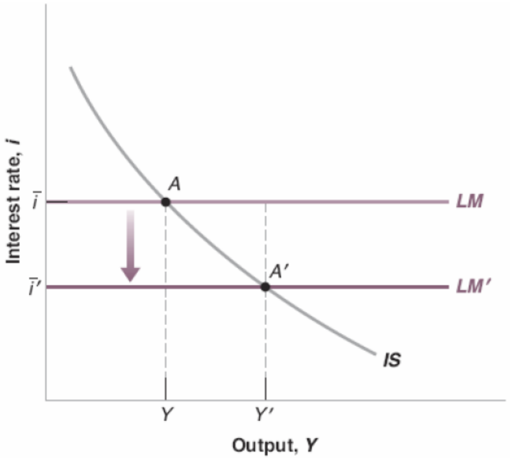
  Decrease in $i \Leftrightarrow$ increase in $M \Leftrightarrow$ **monetary expansion**

  Increase in $i \Leftrightarrow$ decrease in $M \Leftrightarrow$ **monetary contraction** $\Leftrightarrow$ **monetary tightening**

5.3 Putting the *IS* and the *LM* Relations Together (5 of 5)

Figure 5.7 The Effects of a Decrease in the Interest Rate

A monetary expansion shifts the *LM* curve down, and leads to higher output.



5.4 Using a Policy Mix (1 of 3)

- Monetary-fiscal **policy mix** is the combination of monetary and fiscal policies.
- Suppose that the economy is in a recession and output is too low.
- Both fiscal and monetary policies can be used to increase output.

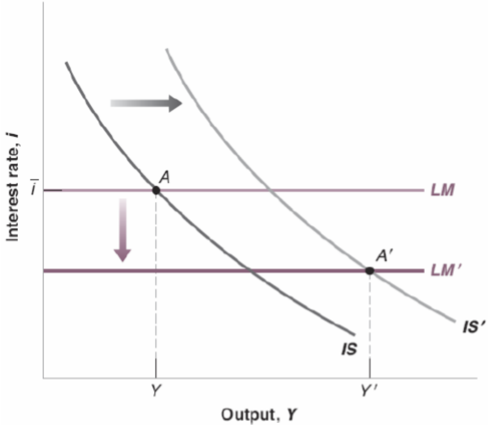
5.4 Using a Policy Mix (2 of 3)

Figure 5.8 The Effects of a Combined Fiscal and Monetary Expansion

The fiscal expansion shifts the *IS* curve to the right.

A monetary expansion shifts the *LM* curve down.

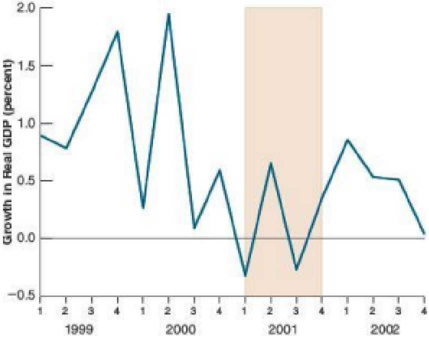
Both lead to higher output.



Focus: The U.S. Recession of 2001 (1 of 3)

Figure 1 The U.S. Growth Rate, 1999 Q1 to 2002 Q4

The National Bureau of Economic Research concluded that the U.S. economy was in a recession between March 2001 and December 2001, triggered by sharp declines in investment demand.



Source: Calculated using Series GDPC1, Federal Reserve Economic Data (FRED)

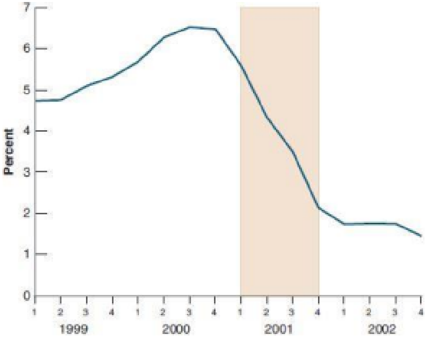
https://fred.stlouisfed.org/series/GDPC1

Focus: The U.S. Recession of 2001 (2 of 3)

Figure 2 The Federal Funds Rate, 1999 Q1 to 2002 Q4

The recession was met by strong macroeconomic policy response.

The Fed cut the federal funds rate from 6.5% in January to 2% at the end of 2001.

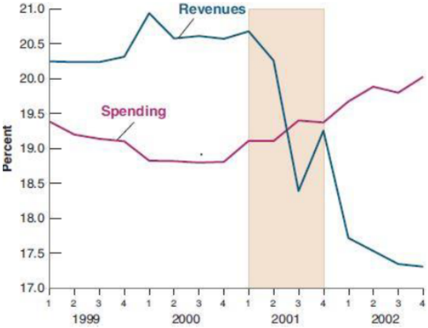


Source: Calculated using Series DFF, Federal Reserve Economic Data (FRED)
https://fred.stlouisfed.org/series/DFF

Focus: The U.S. Recession of 2001 (3 of 3)

Figure 3 U.S. Federal Government Revenues and Spending (as Ratios to GDP), 1999 Q1 to 2002 Q4

President George Bush cut taxes in 2001 and 2002 budgets. The events of September 11, 2001 also lead to an increase in spending on defense and homeland security.



Source: Calculated using Series GDPC1, FGRECPT, FGEXPND, Federal Reserve Economic Data (FRED) https://fred.stlouisfed.org/series/FGEXPND

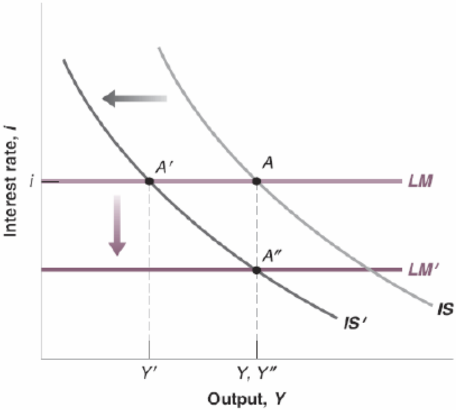
5.4 Using a Policy Mix (3 of 3)

Figure 5.9 The Effects of a Combined Fiscal Consolidation and Monetary Expansion

The fiscal consolidation shifts the *IS* curve to the left.

A monetary expansion shifts the *LM* curve down.

This allows for the reduction in the deficit without a recession.

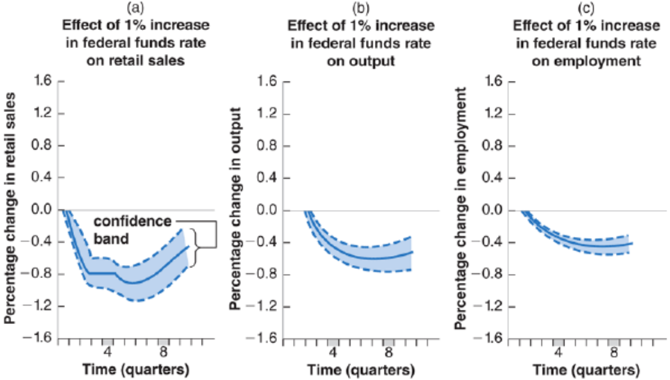


5.5 How Does the *IS-LM* Model Fit the Facts? (1 of 3)

- Because the adjustment of output takes time, we need to reintroduce **dynamics**:
  - Consumers are likely to take time to adjust their consumption following a change in disposable income.
  - Firms are likely to take time to adjust investment spending following a change in their sales.
  - Firms are likely to take time to adjust investment spending following a change in the interest rate.
  - Firms are likely to take time to adjust production following a change in their sales.

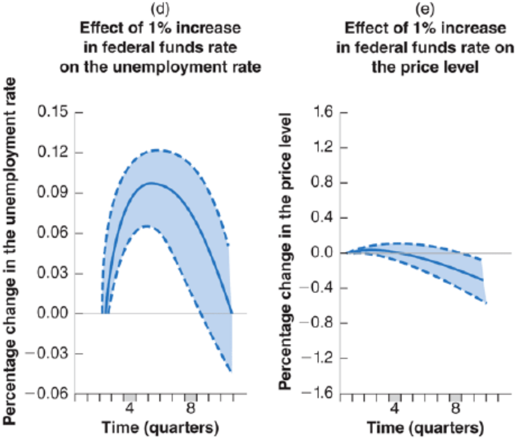
Figure 5.10 The Empirical Effects of an Increase in the Federal Funds Rate

In the short run, an increase in the federal funds rate leads to a decrease in output and to an increase in unemployment, but it has little effect on the price level.



Source: Lawrence Christiano, Martin Eichenbaum, and Charles Evans (1996). The Effects of Monetary Policy Shocks: Evidence From the Flow of Funds, *Review of Economics and Statistics*, 78: 16-34.

Figure 5.10 The Empirical Effects of an Increase in the Federal Funds Rate



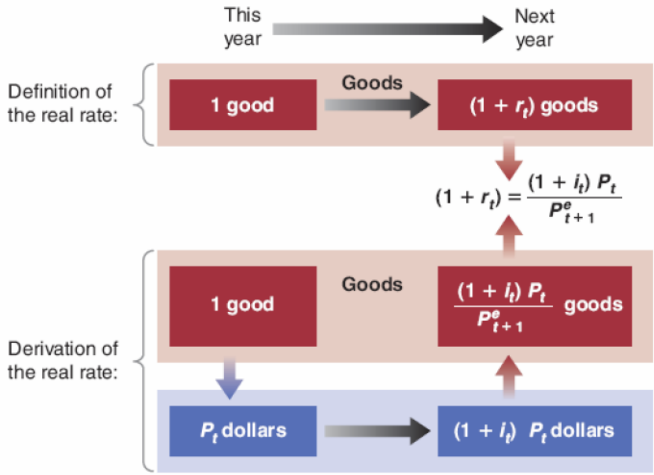
Source: Lawrence Christiano, Martin Eichenbaum, and Charles Evans (1996). The Effects of Monetary Policy Shocks: Evidence From the Flow of Funds, *Review of Economics and Statistics*, 78: 16-34.

6.1 Nominal versus Real Interest Rates (1 of 5)

- **Nominal interest rate** is the interest rate in terms of dollars.
- **Real interest rate** is the interest rate in terms of a basket of goods.
- We must adjust the nominal interest rate to take into account expected inflation.

6.1 Nominal versus Real Interest Rates (2 of 5)

Figure 6.1 Definition and Derivation of the Real Interest Rate



6.1 Nominal versus Real Interest Rates (3 of 5)

- One-year real interest rate r_t:

$$1 + r_t = (1 + i_t)\frac{P_t}{P^e_{t+1}} \tag{2.18}$$

- Denote expected inflation between t and $t + 1$ by:

$$\pi^e_{t+1} = \frac{P^e_{t+1} - P_t}{P_t} \tag{2.19}$$

so that Eq. (2.18) becomes

$$1 + r_t = \frac{1 + i_t}{1 + \pi^e_{t+1}} \tag{2.20}$$

6.1 Nominal versus Real Interest Rates (4 of 5)

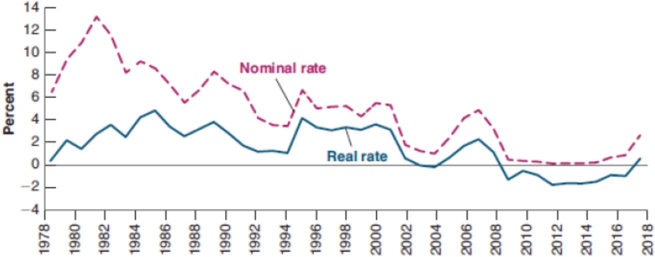
- If the nominal interest rate and expected inflation are not too large, a close approximately to Eq. (2.20) is:

$$r_t \approx i_t - \pi^e_{t+1} \tag{2.21}$$

- When expected inflation equals zero, the nominal interest rate and the real interest rate are equal.
- Because expected inflation is typically positive, the real interest rate is typically lower than the nominal interest rate.
- For a given nominal interest rate, the higher expected inflation, the lower the real interest rate.

Figure 6.2 Nominal and Real One-Year T-Bill Rates in the United States since 1978

The nominal interest rate has declined considerably since the early 1980s, but because expected inflation has declined as well, the real rate has declined much less than the nominal rate.



Source: FRED: Nominal interest rate is the 1-year Treasury bill in December of the previous year: Series TB1YR (Series TB6MS in December 2001, 2002, 2003, and 2004.). Expected inflation is the 12-month forecast of inflation, using the GDP deflator, from the November OECD Economic Outlook from the previous year.

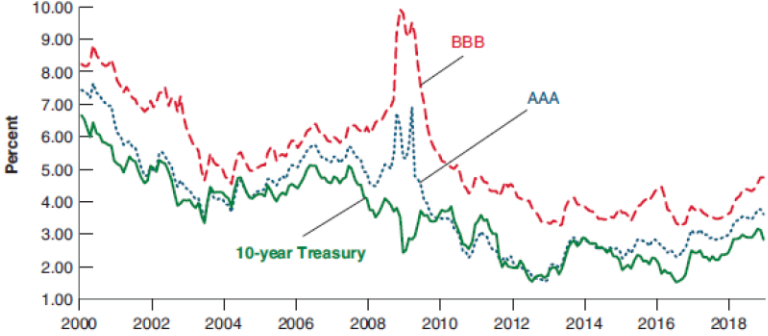
6.2 Risk and Risk Premia (1 of 2)

- Since some bonds are risky, bond holders require a **risk premium** to hold these bonds.
- Risk premia are determined by:
  - The probability of default
  - The degree of risk aversion of bond holders

6.2 Risk and Risk Premia (2 of 2)

Figure 6.3 Yields on 10-Year U.S. Government Treasury, AAA, and BBB Corporate Bonds, since 2000

In September 2008, the financial crisis led to a sharp increase in the rates at which firms could borrow.



Source: FRED: Series DGS10. For AAA and BBB corporate bonds, Bank of America Merrill Lynch Series BAMLC0A1CAAAEY and BAMLC0A4CBBB.

6.3 The Role of Financial Intermediaries

- Until now, we have looked at direct finance – borrowing directly by the ultimate borrowers from the ultimate lenders.
- In fact, much of the borrowing and lending takes place through **financial intermediaries** – financial institutions that receive funds from investors and then lend these funds to others.

6.4 Extending the *IS*-*LM* Model (1 of 3)

- Now we extend the *IS*-*LM* model to reflect the distinction between:
  1. the nominal interest rate and the real interest rate
  2. the policy rate set by the central bank and the interest rates faced by borrowers
- Rewrite the *IS*-*LM* model:

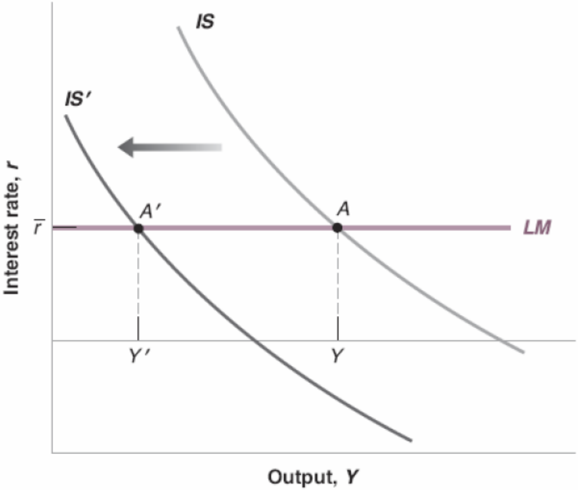
$$\begin{aligned} IS \text{ relation: } Y &= C(Y-T) + I(Y, r+x) + G && (2.22) \\ LM \text{ relation: } r &= \bar{r} && (2.23) \end{aligned}$$

  where expected inflation π^e and the risk premium x enter the *IS* relation.
- The central bank now chooses the **real policy rate** r, which enters the *IS* equation as part of the **borrowing rate** $(r+x)$ for consumers and firms.

6.4 Extending the *IS*-*LM* Model (2 of 3)

Figure 6.5 Financial Shocks and Output

An increase in x leads to a shift of the *IS* curve to the left and a decrease in equilibrium output.

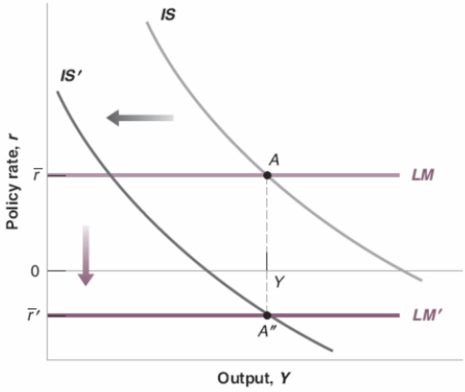


6.4 Extending the *IS*-*LM* Model (3 of 3)

Figure 6.6 Financial Shocks, Monetary Policy, and Output

If sufficiently large, a decrease in the policy rate can in principle offset the increase in the risk premium.

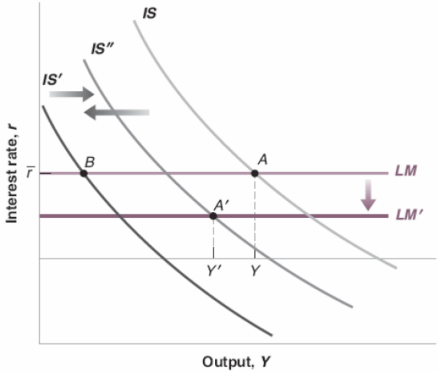
The **zero lower bound** may however put a limit on the decrease in the real policy rate.



6.5 From a Housing Problem to a Financial Crisis (1 of 2)

Figure 6.9 The Financial Crisis, and the Use of Financial, Fiscal, and Monetary Policies

The financial crisis led to a shift of the *IS* curve to the left. Financial and fiscal policies led to some shift back of the *IS* curve to the right. Monetary policy led to a shift of the *LM* curve down. Policies were not enough however to avoid a major recession.



6.5 From a Housing Problem to a Financial Crisis (2 of 2)

- Monetary policy:
  - The federal funds rate was down to zero by December 2008.
  - The Fed also used unconventional monetary policy, which involved buying other assets as to directly affect the rate faced by borrowers.
- Fiscal Policy:
  - The American Recovery and Reinvestment Act was passed in February 2009, calling for $780 billion in tax reductions and spending increases.

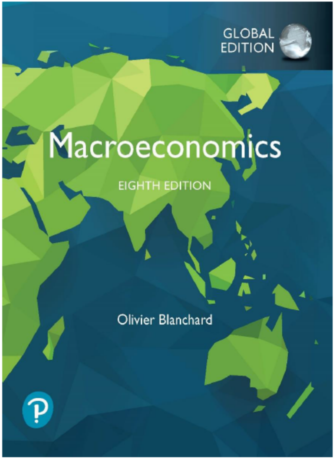
Summary

- The *IS*-*LM* model analyzes the implications of a simultaneous equilibrium on goods and financial markets.
- Expansionary (contractionary) fiscal policy shifts the *IS* curve to the right (left). This leads to an increase (decrease) in production.
- Expansionary (contractive) monetary policy shifts the *LM* curve down (up) by lowering (increasing) the interest rate. This leads to an increase (decrease) in production.
- The combination of monetary and fiscal policies is called policy mix.
- The *IS*-*LM* model appears to describe the short run behavior of the economy quite well.

Contents

Macroeconomics

Eighth Edition, Global Edition



Pearson

Chapters 7 - 9

The Medium Run

The Phillips Curve and the *IS-LM-PC* Model

Outline

The Medium Run

7. The Labor Market

8. The Phillips Curve, the Natural Rate of Unemployment, and Inflation

9. From the Short to the Medium Run: The *IS-LM-PC* Model

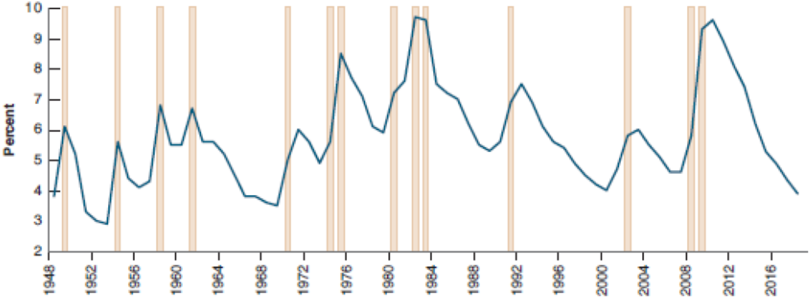
The Labor Market

- We have focused on the *short run* by assuming a **constant price level** in the *IS-LM* model.
- We now turn to the *medium run* and explore how prices and wages adjust over time, and how this in turn affects output.
- The *labor market* is the center of that sequence of events.

7.2 Movements in Unemployment (1 of 2)

Figure 7.3 Movements in the U.S. Unemployment Rate, 1948-2018

Since 1948, the average yearly U.S. unemployment rate has fluctuated between 3 and 10%.



Source: UNRATE, Federal Reserve Economic Data (FRED).

7.2 Movements in Unemployment (2 of 2)

- When unemployment is high, workers are worse off in two ways:
  - Employed workers face a higher probability of losing their job.
  - Unemployed workers face a lower probability of finding a job; or they can expect to remain unemployed for a longer time.

7.3 Wage Determination (1 of 4)

- Sometimes wages are set by **collective bargaining** – a bargaining between unions and firms.
- Slightly more than 10% of U.S. workers' wages are set by collective bargaining.
- The higher the skills needed to do the job, the more likely there is to be bargaining between employers and individual employees.
- Collective bargaining plays an important role in Japan and most European countries.

7.3 Wage Determination (2 of 4)

- Workers are typically paid a wage exceeding their **reservation wage** – the wage that would make them indifferent between working or being unemployed.
- Wages typically depend on labor-market conditions: The lower the unemployment rate, the higher the wages.
- Workers' **bargaining power** depends on:
  - How costly for the firm to find other workers
  - How hard for workers to find another job if they were to leave the firm

7.3 Wage Determination (3 of 4)

- The **aggregate nominal wage** W depends on:
  - the expected price level P^e
  - the unemployment rate u
  - a catch-all variable z

$$W = P^e F\underset{(-,+)}{(u, z)} \tag{3.1}$$

- Both workers and firms care about real wages (W/P), not nominal wages.
- The nominal wage depends on the expected price level (rather than the actual price level) because when nominal wages are set, the relevant price levels are not yet known.

7.3 Wage Determination (4 of 4)

- An increase in the unemployment rate decreases wages.
- Higher unemployment either weakens worker' bargaining power or allows firms to pay lower wages and still keep workers willing to work.
- z stands for all the factors that affect wages given the expected price level and the unemployment rate, for example:
  - **unemployment insurance** as the payment of unemployment benefits to workers who lose their jobs
  - **employment protection** makes it more expensive for firms to lay off workers

7.4 Price Determination (1 of 2)

- The prices set by firms depend on their costs, which in turn depend on the nature of the **production function**:

$$Y = AN$$

  where Y is output, N is employment and A is **labor productivity** (output per worker).

- The production function is the relation between the inputs used in production and the quantity of output produced.

7.4 Price Determination (2 of 2)

- Assume that A is constant and $A = 1$, then:

$$Y = N \tag{3.2}$$

which implies that the cost of producing one more unit of output is the cost of employing one more worker at W.

- The marginal cost of production is equal to W.
- Now assume firms set their price according to a **markup** m over the cost so that:

$$P = (1 + m)W \tag{3.3}$$

7.5 The Natural Rate of Unemployment (1 of 6)

- Assume that W depends on the actual price level (P) rather than the expected price level (P^e), Eq. (3.1) becomes:

$$\frac{W}{P} = F\underset{(-,+)}{(u, z)} \tag{3.4}$$

- *The higher the unemployment rate, the lower the real wage chosen by wage setters.*
- The wage-setting relation is the relation between the real wage and the rate of unemployment.

7.5 The Natural Rate of Unemployment (2 of 6)

- Now divide both sides of the price-determination Eq. (3.3) by the nominal wage:

$$\frac{P}{W} = 1 + m \tag{3.5}$$

- Inverting both sides gives the implied real wage, or the **price-setting relation**:

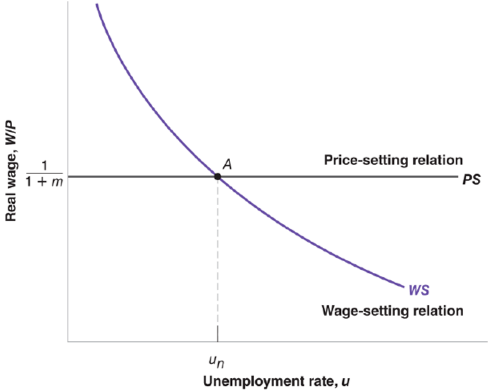
$$\frac{W}{P} = \frac{1}{1 + m} \tag{3.6}$$

- *Price-setting decisions determine the real wage paid by firms.*

7.5 The Natural Rate of Unemployment (3 of 6)

Figure 7.6 Wages, Prices, and the Natural Rate of Unemployment

The natural rate of unemployment is the unemployment rate such that the real wage chosen in wage setting is equal to the real wage implied by price setting.



7.5 The Natural Rate of Unemployment (4 of 6)

- The equilibrium unemployment rate u_n can be derived by eliminating W/P between Eqs. (3.4) and (3.6):

$$F(u_n, z) = \frac{1}{1+m} \tag{3.7}$$

- u_n depends on z and m.
- u_n is also called the **natural rate of unemployment** or the **structural rate of unemployment**.

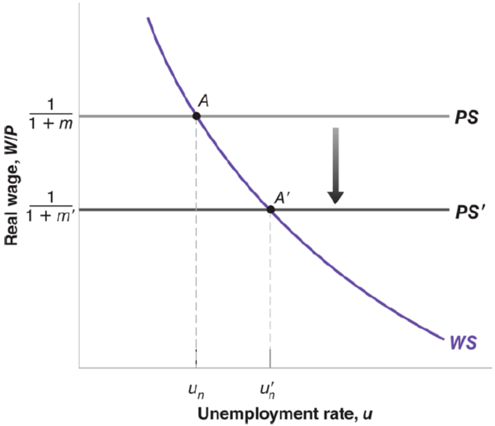
Figure 7.7 Unemployment Benefits and the Natural Rate of Unemployment

An increase in unemployment benefits leads to an increase in the natural rate of unemployment.

7.5 The Natural Rate of Unemployment (6 of 6)

Figure 7.8 Markups and the Natural Rate of Unemployment

An increase in the markup leads to an increase in the natural rate of unemployment.



8.1 Inflation, Expected Inflation, and Unemployment (1 of 3)

- Recall the wage determination Eq. (3.1):

$$W = P^e F(u, z) \tag{3.8}$$

and the price determination Eq. (3.3):

$$P = (1 + m)W \tag{3.9}$$

8.1 Inflation, Expected Inflation, and Unemployment (2 of 3)

- Assume a specific form for $F(u, z)$:

$$F(u, z) = 1 - \alpha u + z$$

so that the relation between the price level, the expected price level, and the unemployment rate is:

$$P = P^e(1 + m)(1 - \alpha u + z) \tag{3.10}$$

or in terms of inflation rate π and expected inflation rate π^e:

$$\pi = \pi^e + (m + z) - \alpha u \tag{3.11}$$

APPENDIX: Derivation of the Relation Between Inflation, Expected Inflation, and Unemployment

- Eq. (3.10) with time subscripts becomes:

$$P_t = P_t^e(1+m)(1-\alpha u_t + z)$$

- Divide both sides by P_{t-1}:

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}}(1+m)(1-\alpha u_t + z) \tag{3.12}$$

- Rewrite P_t/P_{t-1} as $1+\pi_t$ and do the same for the expected inflation rate, Eq. (3.12) becomes:

$$(1+\pi_t) = (1+\pi_t^e)(1+m)(1-\alpha u_t + z)$$
$$\frac{(1+\pi_t)}{(1+\pi_t^e)(1+m)} = (1-\alpha u_t + z)$$

- If the terms on the left side are not large, it becomes $1+\pi_t-\pi_t^e-m$ and so we get Eq. (3.11) (see Appendix 2, Prop. 3 and 6):

$$\pi_t = \pi_t^e + (m+z) - \alpha u_t$$

8.1 Inflation, Expected Inflation, and Unemployment (3 of 3)

- An increase in π^e leads to an increase in π.
- Given π^e, an increase in m, or an increase in z, leads to an increase in π.
- Given π^e, a decrease in u leads to an increase in π.
- Eq. (3.11) with time index t:

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t \tag{3.13}$$

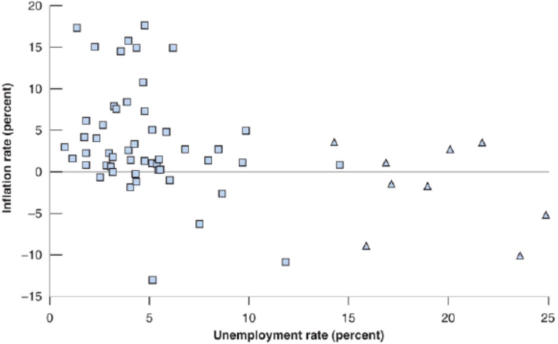
The Phillips Curve, the Natural Rate of Unemployment, and Inflation

- In 1958 A.W. Phillips found a negative relation between inflation and unemployment.
- Two years later, Paul Samuelson and Robert Solow labeled this relation the **Phillips curve**, which became central to macroeconomic thinking and policy.

The Phillips Curve

Figure 8.1 Inflation versus Unemployment in the United States, 1900-1960

During the period 1900-1960 in the United States, a low unemployment rate was typically associated with a high inflation rate, and a high unemployment rate was typically associated with a low or negative inflation rate.



Source: Based on Historical Statistics of the United States.
http://hsus.cambridge.org/HSUSWeb/index.do.

8.2 The Phillips Curve and Its Mutations (1 of 9)

- Assume $\pi_t^e = \bar{\pi}$, so that Eq. (3.13) becomes:

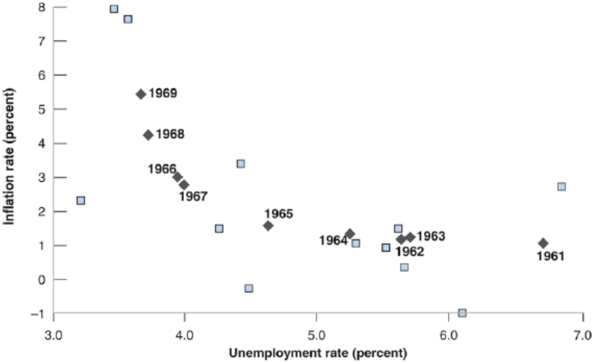
$$\pi_t = \bar{\pi} + (m + z) - \alpha u_t \tag{3.14}$$

  which is a negative relation between unemployment and inflation.
- This Phillips curve relation was observed in the United States in the 1960s.
- The relation vanished in the 1970s because wage setters changed the way they formed inflation expectations.

8.2 The Phillips Curve and Its Mutations (2 of 9)

Figure 8.2 Inflation versus Unemployment in the United States, 1961-1969

The steady decline in the U.S. unemployment rate throughout the 1960s was associated with a steady increase in the inflation rate.

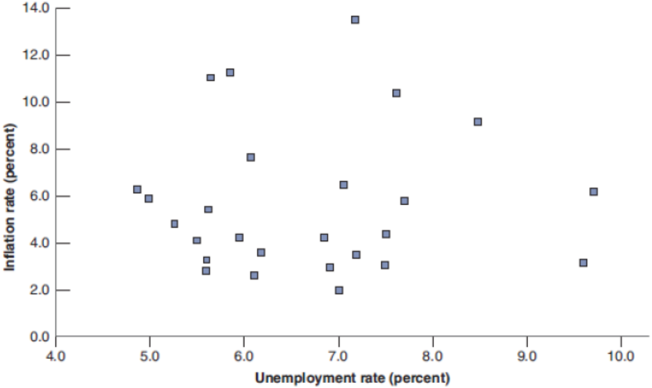


Source: FRED: Series UNRATE, CPIAUCSL

8.2 The Phillips Curve and Its Mutations (3 of 9)

Figure 8.3 Inflation versus Unemployment in the United States, 1970-1995

Beginning in 1970 in the United States, the relation between the unemployment rate and the inflation rate disappeared.



Source: FRED: Series UNRATE, CPIAUCSL

- Suppose expected inflation this year depends on a constant value $\bar{\pi}$ with weight $1-\theta$, and on inflation last year with weight θ:

$$\pi_t^e = (1-\theta)\bar{\pi} + \theta\pi_{t-1} \tag{3.15}$$

- When $\theta = 0$,

$$\pi_t = \bar{\pi} + (m+z) - \alpha u_t$$

- When $\theta > 0$,

$$\pi_t = [(1-\theta)\bar{\pi} + (m+z)] + \theta\pi_{t-1} - \alpha u_t$$

- When $\theta = 1$,

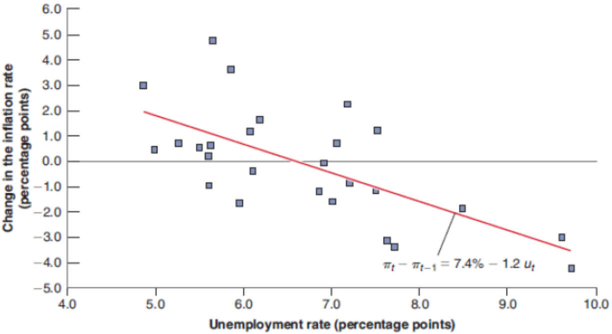
$$\pi_t - \pi_{t-1} = (m+z) - \alpha u_t \tag{3.16}$$

  So the unemployment rate affects not the inflation rate, but rather the change in the inflation rate.

8.2 The Phillips Curve and Its Mutations (5 of 9)

Figure 8.4 Change in Inflation versus Unemployment in the United States, 1970-1995

From 1970 to 1995, there was a negative relation between the unemployment rate and the change in the inflation rate in the United States.



Source: FRED: Series UNRATE, CPIAUCSL

- The line that best fits the scatter of points in **Figure 8.4** is:

$$\pi_t - \pi_{t-1} = 7.4\% - 1.2u_t \tag{3.17}$$

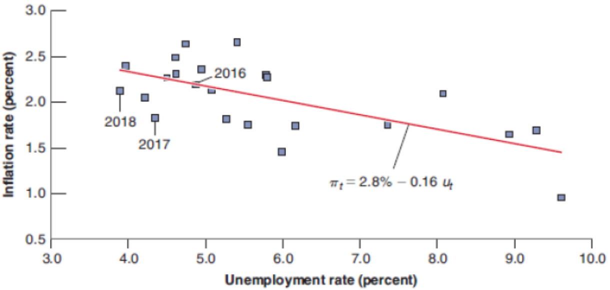
which became known as the **accelerationist Phillips curve**.

8.2 The Phillips Curve and Its Mutations (7 of 9)

- By the mid-1990s the Fed had largely achieved its goal of keeping inflation around 2%.
- Stable inflation changed the way people formed expectations yet again.
- Expectations of inflation that became de-anchored during the 1970s and 1980s became re-anchored in the mid-1990s.

Figure 8.5 Inflation versus Unemployment in the United States, 1996-2018

Since the mid-1990s, the Phillips curve has taken the form of a relation between the inflation rate and the unemployment rate.



Source: FRED: Series UNRATE, CPIAUCSL

8.2 The Phillips Curve and Its Mutations (9 of 9)

- **Figure 8.5** also plots the line that best fits the scatter of points for the period 1996-2018 given by:

$$\pi_t = 2.8\% - 0.16 u_t \qquad (3.18)$$

8.3 The Phillips Curve and the Natural Rate of Unemployment (1 of 2)

- Suppose $\pi = \pi^e$ and solve for u_n in Eq. (3.13):

$$u_n = \frac{m + z}{\alpha} \tag{3.19}$$

- Rewrite Eq. (3.13) as

$$\pi_t - \pi_t^e = -\alpha \left(u_t - \frac{m + z}{\alpha} \right)$$

- Using Eq. (3.19) it can be rewritten as

$$\pi_t - \pi_t^e = -\alpha(u_t - u_n) \tag{3.20}$$

8.3 The Phillips Curve and the Natural Rate of Unemployment (2 of 2)

Using Eq. (3.18) and putting $\pi_t = 2\%$ (target rate) gives:

$$2\% = 2.8\% - 0.16u_n \Rightarrow u_n = \frac{0.8}{0.16} = 5.0\%$$

Focus: Theory ahead of Facts: Milton Friedman and Edmund Phelps

- Milton Friedman and Edmund Phelps argued that the trade-off between inflation and unemployment in the late 1960s was an illusion.
- Accordingly, the Phillips curve is a temporary, rather than a permanent, trade-off between inflation and unemployment that comes not from inflation per se, but from a rising rate of inflation, which results in unanticipated inflation.

8.4 A Summary and Many Warnings

- When the unemployment rate is above (below) the natural rate of unemployment, the inflation rate typically decreases (increases).
- The natural rate of unemployment differs across countries due to, e.g., **labor-market rigidities**, and also over time.
- When the inflation rate becomes high, the terms of wage agreements tend to change with the level of inflation.
- When low inflation or deflation occurs, the Phillips curve relation breaks down.
- One possible reason is the reluctance of workers to accept cuts in nominal wages.

From the Short to the Medium Run: The *IS-LM-PC* Model

- In Chapters 3 through 6, we looked at equilibrium in the goods and financial markets, and how output is determined in the short run.
- In Chapters 7 and 8, we looked at the labor market.
- We now put the two parts together and use this *IS-LM-PC* (*PC* for Phillips curve) model to characterize the behavior of output both in the short run and the medium run.

9.1 The *IS-LM-PC* Model (1 of 3)

- In Chapter 6, output in the short run is determined by demand (***IS* curve**):

$$Y = C(Y - T) + I(Y, r + x) + G \tag{3.21}$$

- In Chapter 8, the relation between inflation and unemployment is called the **Phillips curve**:

$$\pi - \pi^e = -\alpha(u - u_n) \tag{3.22}$$

- When $u = u_n$, natural employment is $N_n = L(1 - u_n)$.
- When $u = u_n$, **potential output** is $Y_n = N_n = L(1 - u_n)$, given Eq. (3.2).
- Output gap: $Y - Y_n = L((1 - u) - (1 - u_n)) = -L(u - u_n)$

9.1 The *IS-LM-PC* Model (2 of 3)

- Output gap: $Y - Y_n = L((1-u) - (1-u_n)) = -L(u - u_n)$
- Replacing $u - u_n$ in Eq. (3.22) gives:

$$\pi - \pi^e = (\alpha/L)(Y - Y_n) \tag{3.23}$$

- Assume wage setters expect inflation this year to be the same as last year:

$$\pi - \pi(-1) = (\alpha/L)(Y - Y_n) \tag{3.24}$$

- When output is above potential (positive output gap), inflation increases, and vice versa.

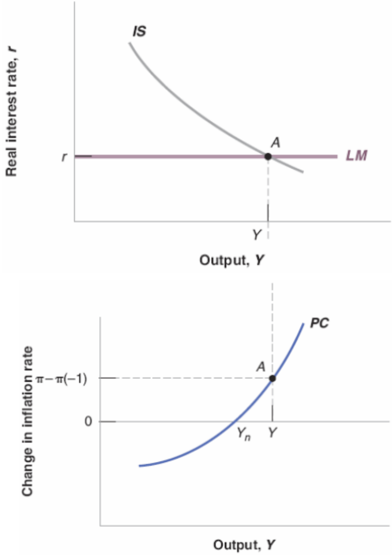
9.1 The *IS-LM-PC* Model (3 of 3)

Figure 9.1 The *IS-LM-PC* Model: Output and Inflation

Short-run equilibrium

Top graph: A low policy rate leads to higher output.

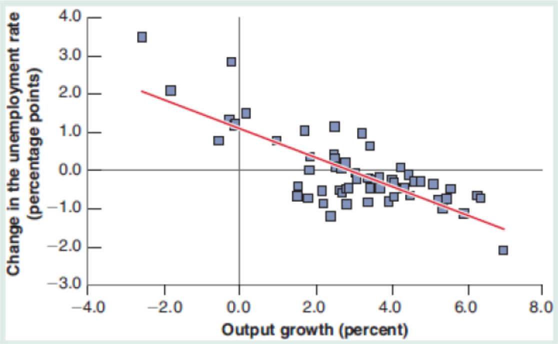
Bottom graph: A higher output leads to a larger change in inflation.



Focus: Okun's Law across Time and Countries (1 of 2)

Figure 1 Changes in the Unemployment Rate versus Output Growth in the United States, 1960-2018

High output growth is associated with a reduction in the unemployment rate; low growth is associated with an increase in the unemployment rate.



Source: FRED: Series UNRATE, GDPCA

Focus: Okun's Law across Time and Countries (2 of 2)

- Okun's law can be written as the change in unemployment that is approximately equal to the negative of the growth rate of output:

$$u - u(-1) \approx -g_y \tag{3.25}$$

- The regression that fits the points in **Figure 1** is:

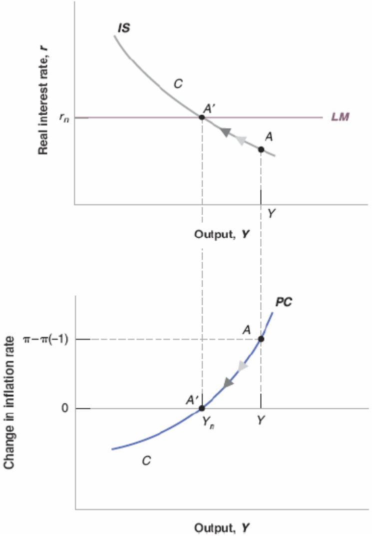
$$u - u(-1) = -0.4(g_y - 3\%) \tag{3.26}$$

- Annual output growth has to be at least 3% to prevent the unemployment rate from rising.
- Output growth 1 percentage point above normal leads only to a 0.4 percentage point reduction in the unemployment rate due to such factors as labor hoarding and discouraged workers.
- The coefficient (-0.4) is called the **Okun coefficient**.

9.2 From the Short to the Medium Run (1 of 2)

Figure 9.2 Medium-Run Output and Inflation

Over the medium run, the economy converges to the natural level of output and stable inflation.
At the medium-run equilibrium (point A'), r_n is called the **natural**, **neutral**, or **Wicksellian rate of interest**.
If the central bank wants to achieve a constant level of inflation, then the initial boom must be followed by a recession.



9.2 From the Short to the Medium Run (2 of 2)

- In the medium run, the real variables are independent of monetary policy.
- Monetary policy determines the rate of inflation and the nominal rate of interest.
- The fact that monetary policy does not affect real variables in the medium run is referred to as the **neutrality of money**.

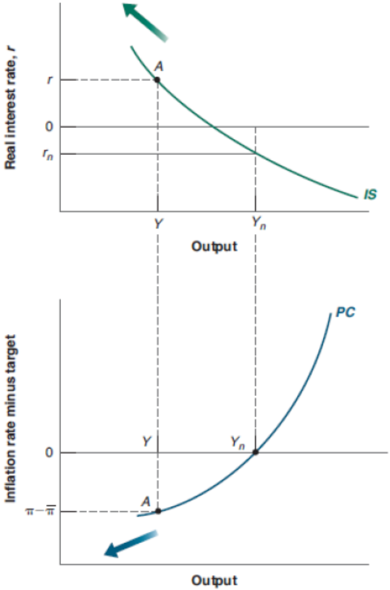
9.3 Complications and How Things Can Go Wrong (1 of 3)

- The adjustment to the medium-run equilibrium in Section 9.2 seemed smooth and easy.
- While this process looks easy to do in **Figure 9.2**, reality is more complicated for two reasons:
  1. It is difficult for the central bank to know where potential output is exactly and thus how far output is from potential.
  2. It takes time for the economy to respond.

9.3 Complications and How Things Can Go Wrong (2 of 3)

Figure 9.3 The Deflation Spiral

If the **zero lower bound** prevents monetary policy from increasing output back to potential, the result may be a **deflation spiral**. More deflation leads to a higher real rate, which in turn leads to lower output and more deflation.



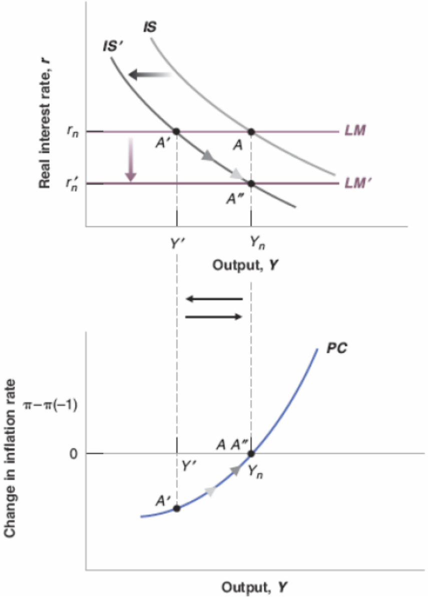
9.3 Complications and How Things Can Go Wrong (3 of 3)

- One issue that can occur is known as a deflation spiral.
- A **deflation spiral** or **deflation trap** results when deflation pushes real interest rates higher, lowers output, and leads to larger and larger deflation.
- This scenario played out during the Great Depression.
- The Great Recession (2007-2009) gave rise to similar concerns.

9.4 Fiscal Consolidation Revisited

Figure 9.4 Fiscal Consolidation in the Short and the Medium Run

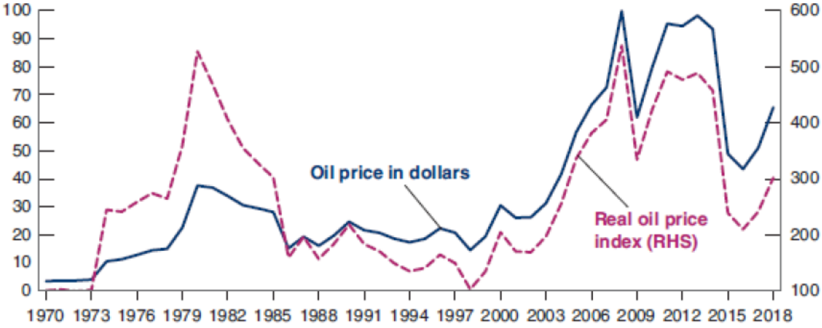
Fiscal consolidation leads to a decrease in output in the short run.
In the medium run, output returns to potential, and the interest rate is lower.
The decrease in consumption (through a tax increase) is offset by an increase in investment (due to the lower interest rate).
A proper combination of fiscal and monetary policy could achieve the medium run equilibrium outcome in the short run.
Difficulty: zero lower bound



9.5 The Effects of an Increase in the Price of Oil (1 of 4)

Figure 9.5 The Nominal and the Real Price of Oil, 1970-2018

Over the last 40 years, there have been two sharp increases in the real price of oil, the first in the 1970s and the second in the 2000s.

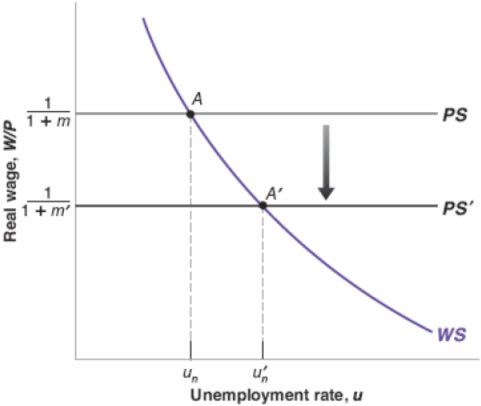


Source: FRED: Series OILPRICE, CPIAUCSL. Left vertical axis: nominal price of oil, dollars per barrel. Right vertical axis: real oil price index, 1970 = 100.

9.5 The Effects of an Increase in the Price of Oil (2 of 4)

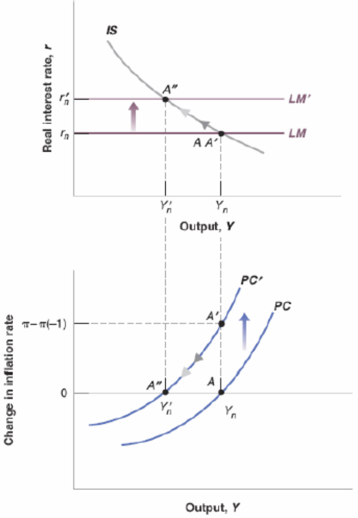
Figure 9.6 The Effects of an Increase in the Price of Oil on the Natural Rate of Unemployment

An increase in the price of oil is equivalent to an *increase in the markup*. It leads to lower real wages and a higher natural rate of unemployment.



9.5 The Effects of an Increase in the Price of Oil (3 of 4)

Figure 9.7 Short- and Medium-Run Effects of an Increase in the Price of Oil



- In the short run, an increase in the price of oil leads to an upshift of the *PC* curve and to higher inflation. If the price increase is **permanent**, it leads to lower output in the medium run (due to the increase in u_n).
- **Stagflation** (lower output and higher inflation) occurs along the way.

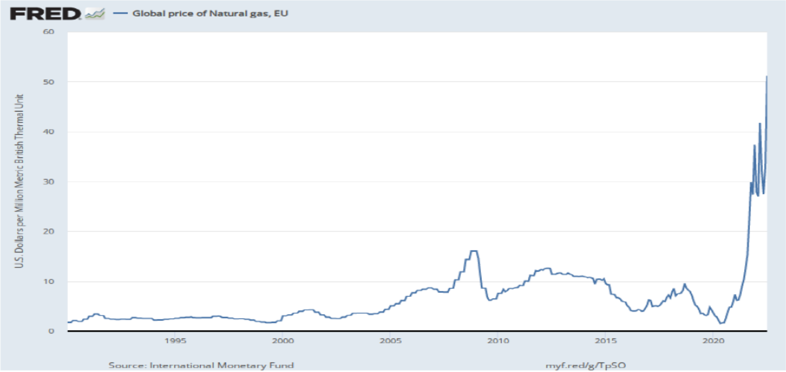
9.5 The Effects of an Increase in the Price of Oil (4 of 4)

- The main issue is whether the increase in the price of oil is **permanent** or **temporary**.
- If it is permanent, it changes potential output and then the central bank has no alternative than to tighten monetary policy to reduce inflation.
- If it is temporary, then the central bank may want to wait until inflation returns to target by itself when the price of oil comes down.
- However, this may be a risky strategy:
  - If the price of oil does not decrease quickly, inflation will remain high for some time.
  - Inflation expectations may de-anchor, leading to higher and higher inflation and a more painful adjustment.

Focus: Huge Increase in Natural Gas Prices (1 of 2)

Figure 1 The Nominal Price of Natural Gas, 1990-2022

Energy prices such as for Natural Gas had been rising since 2021, and sharply increased in 2022 with the Russian invasion of Ukraine.



Source: FRED: Series PNGASEUUSDM.

Focus: Huge Increase in Natural Gas Prices (2 of 2)

- At first, the ECB responded as if this was a temporary markup shock, as opposed to a permanent shock to potential output.
- Policy tolerated a sharp increase in inflation, predicting it to be temporary.
- In July 2022 the ECB started raising its main policy rate up to 4.5% in September 2023.
- However, inflation expectations already started to de-anchor.

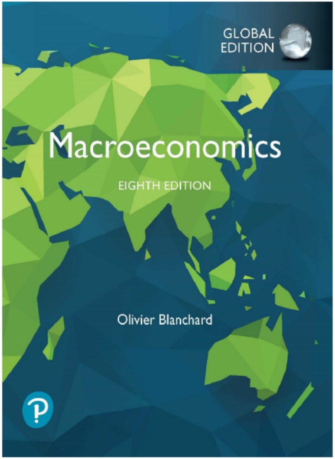
Summary

- Shocks or changes in policy typically have different effects in the short run and in the medium run.
- Disagreements about the effects of various policies depend on how fast you think the economy adjusts to shocks.
- Movements in output around its trend are called **output fluctuations (business cycles)**.
- **Economic fluctuations** are the result of shocks and their dynamic effects, called the **propagation mechanism**.

Contents

Macroeconomics

Eighth Edition, Global Edition



Pearson

Chapters 10 - 13

The Long Run

Growth

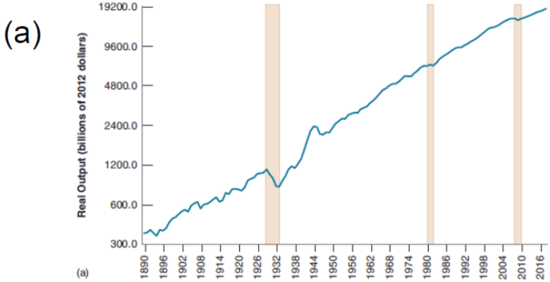
Outline

The Long Run

The Facts of Growth

- **Growth** is the steady increase in aggregate output over time.
- We now shift our focus from economic fluctuations and the determination of output in the *short and medium run* to growth and the determination of output in the *long run*.

Figure 10.1 U.S. GDP since 1890 and U.S. GDP per person since 1890 (1 of 2)

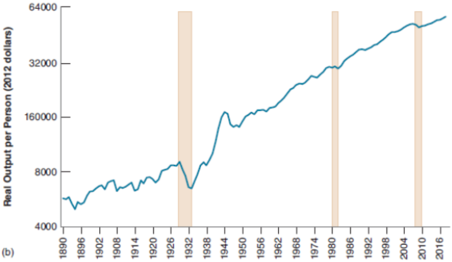


Panel (a) shows the enormous increase in U.S. output since 1890, by a factor of 51.

Source: 1890-1947: Historical Statistics of the United States, 1948-2014: National Income and Product Accounts. Population estimates 1890-2014: Louis Johnston and Samuel H. Williamson (2015). What Was the US GDP Then? Measuring Worth, `www.measuringworth.com/datasets/usgdp/`. More recent data: FRED: GDPC1, B230RC0Q173SBEA.

Figure 10.1 U.S. GDP since 1890 and U.S. GDP per person since 1890 (2 of 2)

(b)



Panel (b) shows that the increase in output is not simply the result of the large increase in U.S. population from 63 million to more than 320 million over this period. Output per person has risen by a factor of 10.

Source: 1890-1947: Historical Statistics of the United States, 1948-2014: National Income and Product Accounts. Population estimates 1890-2014: Louis Johnston and Samuel H. Williamson (2015). What Was the US GDP Then? Measuring Worth, `www.measuringworth.com/datasets/usgdp/`. More recent data: FRED: GDPC1, B230RC0Q173SBEA.

10.4 Thinking About Growth: A Primer (1 of 4)

- Aggregate production function F:

$$Y = F(K, N) \tag{4.1}$$

where Y is output, K is capital, and N is labor.

- The function F depends on the **state of technology**.
- **Constant returns to scale**:

$$xY = F(xK, xN) \tag{4.2}$$

- **Decreasing returns to capital**: Increases in capital lead to smaller and smaller increases in output.
- **Decreasing returns to labor**: Increases in labor lead to smaller and smaller increases in output.

10.4 Thinking About Growth: A Primer (2 of 4)

- The production function and constant returns to scale imply a simple relation between output per worker (Y/N) and capital per worker (K/N):

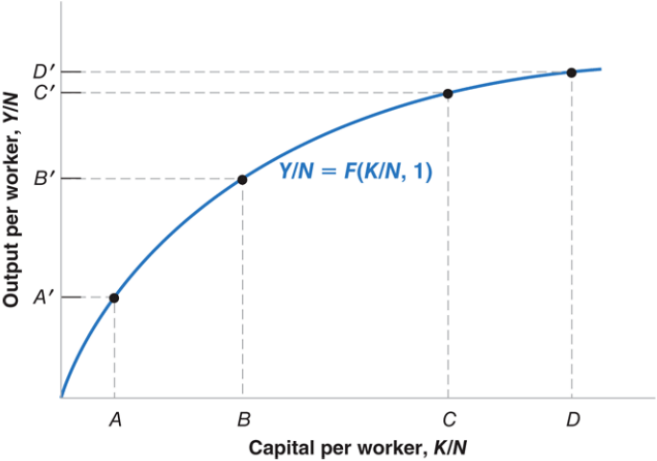
$$\frac{Y}{N} = F\left(\frac{K}{N}, \frac{N}{N}\right) = F\left(\frac{K}{N}, 1\right) \tag{4.3}$$

- Increases in capital per worker: Movements along the production function.
- Improvements in the state of technology: Shifts (up) of the production function.
- Growth comes from **capital accumulation** (a higher **saving rate**) and **technological progress** (the improvement in the state of technology).

10.4 Thinking About Growth: A Primer (3 of 4)

Figure 10.4 Output and Capital per Worker

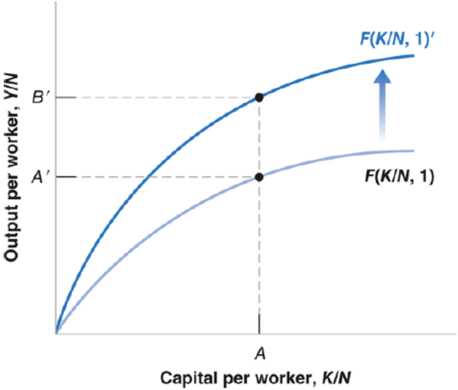
Decreasing returns to capital: Increases in capital per worker lead to smaller and smaller increases in output per worker.



10.4 Thinking About Growth: A Primer (4 of 4)

Figure 10.5 The Effects of an Improvement in the State of Technology

An improvement in technology shifts the production function up, leading to an increase in output per worker for a given level of capital per worker.

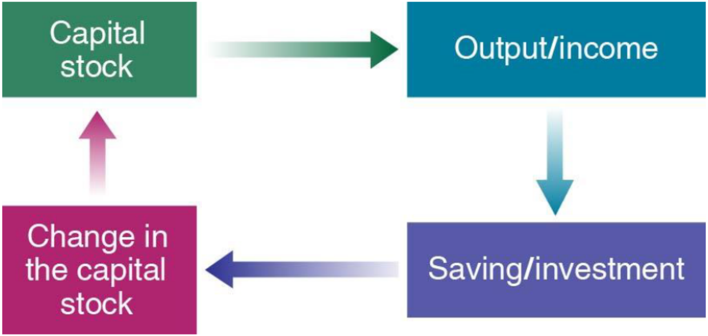


11.1 Interactions between Output and Capital (1 of 5)

- Output in the long run depends on two relations:
  - The amount of capital determines the amount of output being produced.
  - The amount of output produced determines the amount of saving, which in turn determines the amount of capital being accumulated over time.

11.1 Interactions between Output and Capital (2 of 5)

Figure 11.1 Capital, Output, and Saving/Investment



11.1 Interactions between Output and Capital (3 of 5)

- Recall from Chapter 10:

$$\frac{Y}{N} = F\left(\frac{K}{N}, 1\right) \quad \text{or} \quad f\left(\frac{K}{N}\right) = F\left(\frac{K}{N}, 1\right)$$

- Assume that N is constant, and there is no technological progress, so f does not change over time:

$$\frac{Y_t}{N} = f\left(\frac{K_t}{N}\right) \tag{4.4}$$

- Higher capital per worker leads to higher output per worker.

11.1 Interactions between Output and Capital (4 of 5)

- Assume:
  - The economy is closed:
  $$I = S + (T - G)$$
  - Public saving ($T - G = 0$):
  $$I = S$$
  - Private saving is proportional to income:
  $$S = sY, \quad 0 < s < 1$$
- So, the relation between output and investment:
$$I_t = sY_t \tag{4.5}$$
- Investment is proportional to output.
- The higher (lower) output is, the higher (lower) is saving and so the higher (lower) is investment.

11.1 Interactions between Output and Capital (5 of 5)

- The evolution of the capital stock is:

$$K_{t+1} = (1-\delta)K_t + I_t$$

- Replace investment by Eq. (4.5) and divide both sides by N:

$$\frac{K_{t+1}}{N} = (1-\delta)\frac{K_t}{N} + s\frac{Y_t}{N}$$

or

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = s\frac{Y_t}{N} - \delta\frac{K_t}{N} \tag{4.6}$$

- The change in the capital stock per worker is equal to saving per worker minus depreciation.

- Combining Eqs. (4.4) and (4.6):

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = sf\left(\frac{K_t}{N}\right) - \delta\frac{K_t}{N} \tag{4.7}$$

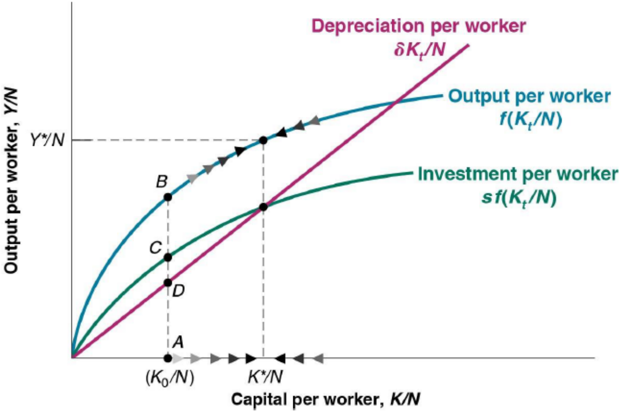
$$\begin{array}{lcll} \text{change in capital} & = & \text{Invesment} & - \text{ depreciation} \\ \text{from year } t \text{ to year } t+1 & & \text{during year t} & \text{ during year t} \end{array}$$

- If investment per worker exceeds (is less than) depreciation per worker, the change in capital per worker is positive (negative).

11.2 The Implications of Alternative Saving Rates (2 of 10)

Figure 11.2 Capital and Output Dynamics

When capital and output are low, investment exceeds depreciation and capital increases. When capital and output are high, investment is less than depreciation and capital decreases.



11.2 The Implications of Alternative Saving Rates (3 of 10)

- The state in which output per worker and capital per worker are no longer changing is called the **steady state** of the economy.

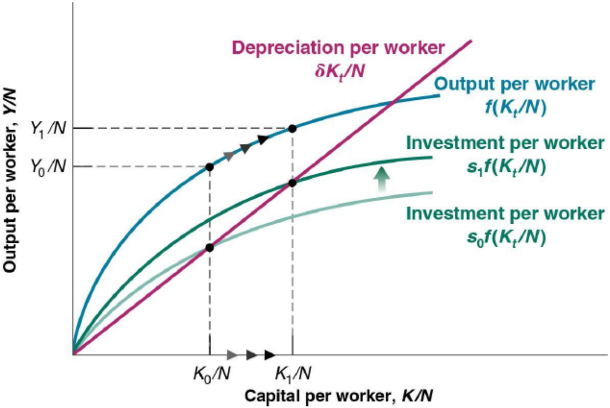
$$sf\left(\frac{K^*}{N}\right) = \delta \frac{K^*}{N} \tag{4.8}$$

- The steady-state value of capital per worker is such that the amount of saving per worker is sufficient to cover depreciation of the capital stock per worker.
- Output per worker in steady state:

$$\frac{Y^*}{N} = f\left(\frac{K^*}{N}\right) \tag{4.9}$$

Figure 11.3 The Effects of Different Saving Rates

A country with a higher saving rate achieves a higher steady-state level of output per worker.



11.2 The Implications of Alternative Saving Rates (5 of 10)

- The saving rate has no effect on the long-run growth rate of output per worker, which is equal to zero.
- The saving rate determines the level of output per worker in the long run.
- An increase in the saving rate will lead to higher growth of output per worker for some time, but not forever.

Figure 11.4 The Effects of an Increase in the Saving Rate on Output per Worker in an Economy Without Technological Progress

An increase in the saving rate leads to a period of higher growth until output reaches its new higher steady-state level.

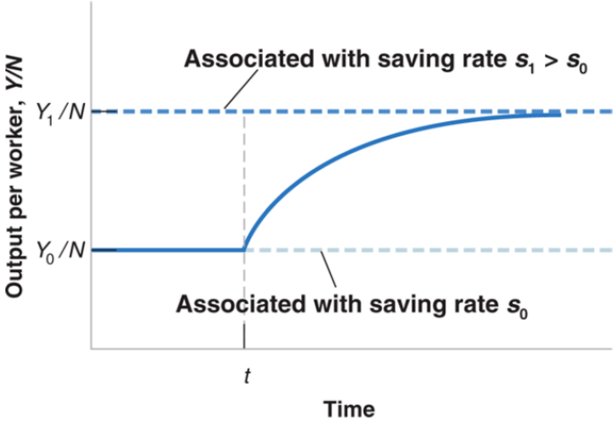
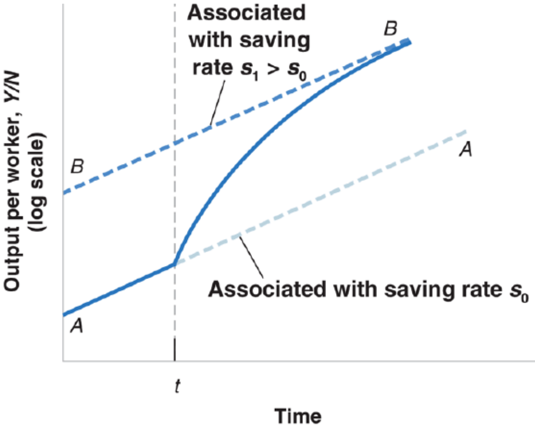


Figure 11.5 The Effects of an Increase in the Saving Rate on Output per Worker in an Economy with Technological Progress

An increase in the saving rate leads to a period of higher growth until output reaches its new higher steady-state level (balanced growth path).

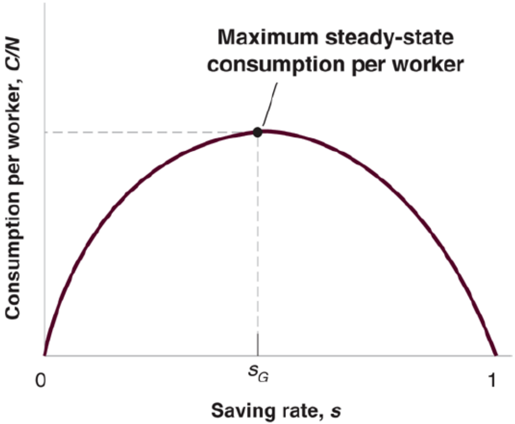


11.2 The Implications of Alternative Saving Rates (8 of 10)

- What matters to people is not how much is produced, but how much they consume.
- Governments can affect the saving rate by:
  - changing public saving (budget surplus)
  - using taxes to affect private saving
- **Golden-rule level of capital**: The level of capital associated with the saving rate that yields the highest level of consumption in steady state

Figure 11.6 The Effects of the Saving Rate on Steady-State Consumption per Worker

An increase in the saving rate leads to an increase, then to a decrease in steady-state consumption per worker.



11.2 The Implications of Alternative Saving Rates (10 of 10)

- For a saving rate between zero and the golden-rule level, a higher saving rate leads to higher capital per worker, higher output per worker and higher consumption per worker.
- For a saving rate greater than the golden-rule level, a higher saving rate still leads to higher capital per worker and output per worker, but lower consumption per worker.
- An increase in the saving rate leads to lower consumption for some time but higher consumption later.

11.3 Getting a Sense of Magnitudes (1 of 6)

- Assume the production function f:

$$Y = \sqrt{K}\sqrt{N} \tag{4.10}$$

- so that Eq. (4.7) becomes:

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = s\sqrt{\frac{K_t}{N}} - \delta\frac{K_t}{N} \tag{4.11}$$

which describes the evolution of capital over time.

11.3 Getting a Sense of Magnitudes (2 of 6)

- Eq. (4.11) implies that capital per worker in the steady state (K^*/N) becomes:

$$\frac{K^*}{N} = \left(\frac{s}{\delta}\right)^2 \tag{4.12}$$

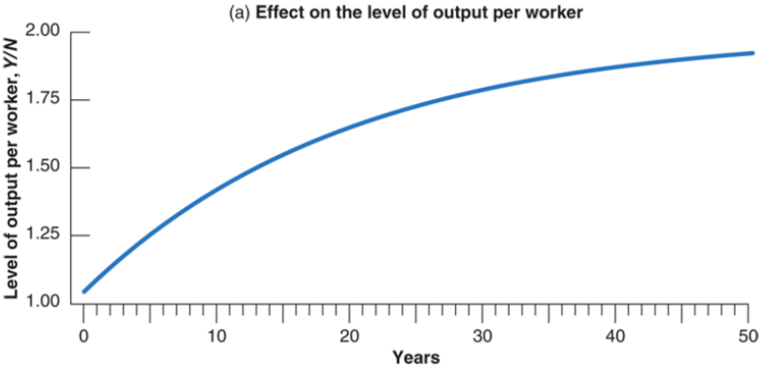
- Combining Eqs. (4.10) and (4.12) gives the steady state output per worker:

$$\frac{Y^*}{N} = \sqrt{\frac{K^*}{N}} = \sqrt{\left(\frac{s}{\delta}\right)^2} = \frac{s}{\delta} \tag{4.13}$$

- In the long run, output per worker doubles when the saving rate doubles.

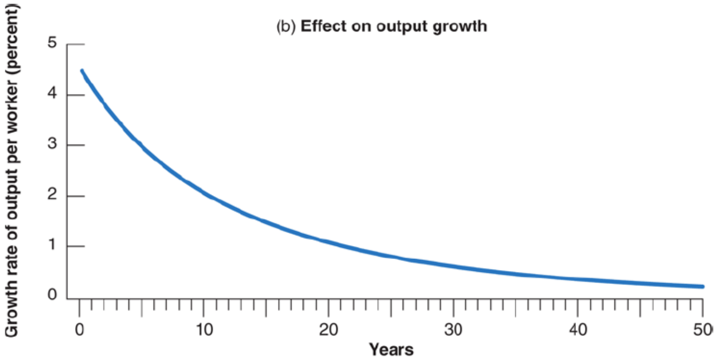
11.3 Getting a Sense of Magnitudes (3 of 6)

Figure 11.7(a) The Dynamic Effects of an Increase in the Saving Rate from 10% to 20% on the Level and the Growth Rate of Output per Worker



It takes a long time for output to adjust to its new higher level after an increase in the saving rate. Put another way, an increase in the saving rate leads to a long period of higher growth.

Figure 11.7(b) The Dynamic Effects of an Increase in the Saving Rate from 10% to 20% on the Level and the Growth Rate of Output per Worker



It takes a long time for output to adjust to its new higher level after an increase in the saving rate. Put another way, an increase in the saving rate leads to a long period of higher growth.

11.3 Getting a Sense of Magnitudes (5 of 6)

- In the steady state, consumption per worker is:

$$\frac{C^*}{N} = \frac{Y^*}{N} - \delta \frac{K^*}{N}$$

- Given Eqs. (4.12) and (4.13), the steady-state consumption per worker is:

$$\frac{C^*}{N} = \frac{s}{\delta} - \delta \left(\frac{s}{\delta}\right)^2 = \frac{s(1-s)}{\delta}$$

- **Table 11.1** gives the steady-state values of capital per worker, output per worker and consumption per worker for different saving rates (given $\delta = 10\%$).

11.3 Getting a Sense of Magnitudes (6 of 6)

Table 11.1 The Saving Rate and the Steady-State Levels of Capital, Output, and Consumption per Worker

Saving Rate s	Capital per Worker K/N	Output per Worker Y/N	Consumption per Worker C/N
0.0	0.0	0.0	0.0
0.1	1.0	1.0	0.9
0.2	4.0	2.0	1.6
0.3	9.0	3.0	2.1
0.4	16.0	4.0	2.4
0.5	25.0	5.0	2.5
0.6	36.0	6.0	2.4
...	...	...	...
1.0	100.0	10.0	0.0

APPENDIX: The Cobb-Douglas Production Function and the Steady State (1 of 2)

- The **Cobb-Douglas production function**:

$$Y = K^{\alpha} N^{1-\alpha} \tag{4.14}$$

  which gives a good description of the relation between output, physical capital, and labor in the United States from 1899 to 1922.[1]

- Relation between output per worker and capital per worker:

$$\frac{Y}{N} = \frac{K^{\alpha} N^{1-\alpha}}{N} = K^{\alpha} N^{-\alpha} = \left(\frac{K}{N}\right)^{\alpha}$$

- In steady state, saving per worker must be equal to depreciation per worker (see Eq. (4.8)), implying that:

$$s(K^*/N)^{\alpha} = \delta(K^*/N)$$

[1] Cobb, C.W., Douglas, P.H. (1928). A Theory of Production. *American Economic Review*, 18(1), 139-165. [DOI]

APPENDIX: The Cobb-Douglas Production Function and the Steady State (2 of 2)

- The preceding expression can be rewritten as:

$$s = \delta(K^*/N)^{1-\alpha}$$

- The steady-state level of capital per worker becomes:

$$(K^*/N) = (s/\delta)^{1/(1-\alpha)}$$

- The steady-state level of output per worker becomes:

$$(Y^*/N) = (K/N)^{\alpha} = (s/\delta)^{\alpha/(1-\alpha)}$$

- If $\alpha = 0.5$, then:

$$Y^*/N = s/\delta$$

which implies that a doubling of the saving rate leads to a doubling in steady-state output per worker (see Eq. (4.13) for comparison).

11.4 Physical versus Human Capital

- **Human capital** (H): The set of skills of the workers in the economy built through education and on-the-job training.
- The production function with human capital:

$$\frac{Y}{N} = \underset{(+,+)}{f\left(\frac{K}{N}, \frac{H}{N}\right)} \tag{4.15}$$

- As for physical capital (K) accumulation, countries that save more or spend more on education can achieve higher steady-state levels of output per worker.

Technological Progress and Growth

- Chapter 11 concluded that sustained growth *requires* technological progress.
- Now we look at the role of technological progress in growth.

12.1 Technological Progress and the Rate of Growth (1 of 10)

- Technological progress can lead to:
  - larger quantities of output for given quantities of capital and labor
  - better products
  - new products
  - a large variety of products
- The **state of technology** (A) is a variable that tells us how much output can be produced from given amounts of capital and labor at any time:

$$Y = F(K, AN) \tag{4.16}$$

so AN is the amount of **effective labor**.

12.1 Technological Progress and the Rate of Growth (2 of 10)

- With constant returns to scale and a given state of technology (A), if the amounts of capital and labor changes by x times, output changes by x times:

$$xY = F(xK, xAN)$$

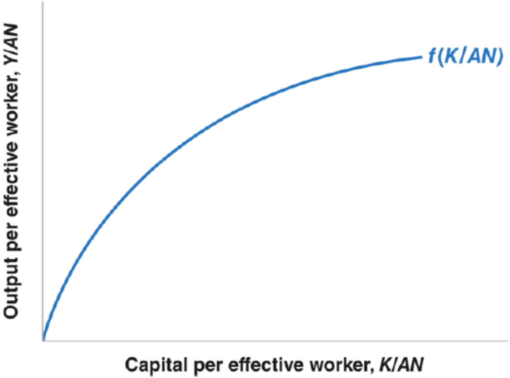
- If $x = 1/AN$, output per effective worker is a function of capital per effective worker:

$$\frac{Y}{AN} = f\left(\frac{K}{AN}\right) \tag{4.17}$$

12.1 Technological Progress and the Rate of Growth (3 of 10)

Figure 12.1 Output per Effective Worker versus Capital per Effective Worker

Because of decreasing returns to capital, increases in capital per effective worker lead to smaller and smaller increases in output per effective worker.



12.1 Technological Progress and the Rate of Growth (4 of 10)

- Recall Chapter 11: $I = S = sY$ using Eq. (4.17) results in (lower curve in **Figure 12.2**):

$$\frac{I}{AN} = sf\left(\frac{K}{AN}\right)$$

- The line in **Figure 12.2** shows the level of investment per effective worker needed to maintain a given level of capital per effective worker because:

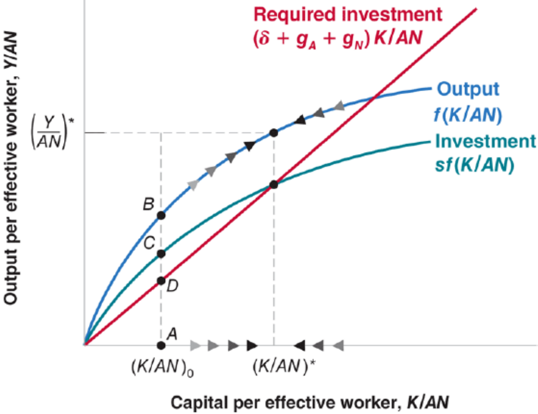
$$I = (\delta + g_A + g_N)K \tag{4.18}$$

where δ is the capital depreciation rate, g_A is the rate of technological progress, and g_N is the rate of population growth.

12.1 Technological Progress and the Rate of Growth (5 of 10)

Figure 12.2 The Dynamics of Capital per Effective Worker and Output per Effective Worker.

Capital per effective worker and output per effective worker converge to constant values in the long run.



12.1 Technological Progress and the Rate of Growth (6 of 10)

- The steady state of the economy is such that capital per effective worker and output per worker are constant, and equal to $(K/AN)^*$ and $(Y/AN)^*$, respectively.
- When the economy is in steady state, output per worker grows at the rate of technological progress (g_A).

12.1 Technological Progress and the Rate of Growth (7 of 10)

Table 12.1 The Characteristics of Balanced Growth

		Growth Rate:
1	Capital per effective worker	0
2	Output per effective worker	0
3	Capital per worker	g_A
4	Output per worker	g_A
5	Labor	g_N
6	Capital	$g_A + g_N$
7	Output	$g_A + g_N$

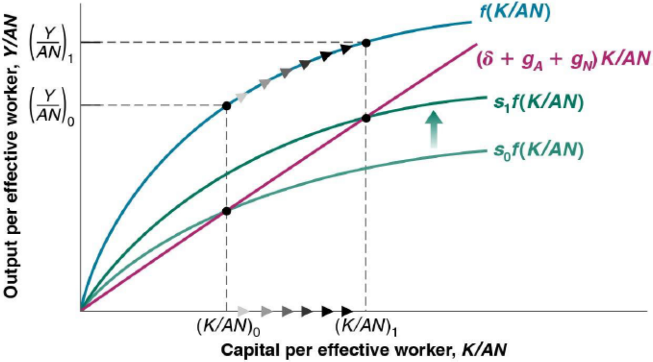
12.1 Technological Progress and the Rate of Growth (8 of 10)

- On the **balanced growth path** (steady state or long run):
  - Capital per effective worker and output per effective worker are constant.
  - Capital per worker and output per worker are growing at the rate of technological progress.
  - Capital and output are growing at a rate equal to the sum of population growth and the rate of technological progress.

12.1 Technological Progress and the Rate of Growth (9 of 10)

Figure 12.3 The Effects of an Increase in the Saving Rate: I

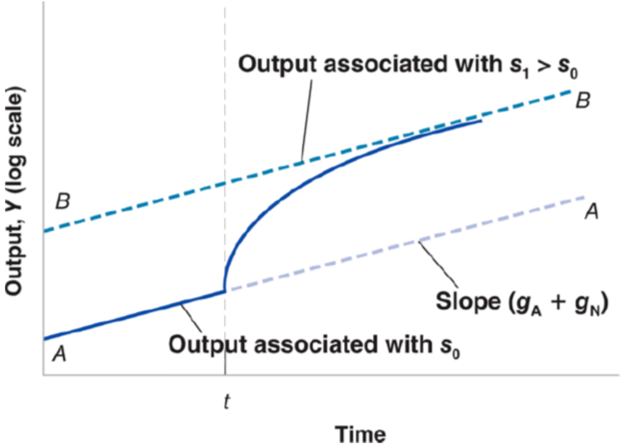
An increase in the saving rate leads to an increase in the steady-state levels of output per effective worker and capital per effective worker.



12.1 Technological Progress and the Rate of Growth (10 of 10)

Figure 12.4 The Effects of an Increase in the Saving Rate: II

The increase in the saving rate leads to higher growth until the economy reaches its new, higher, balance growth path.



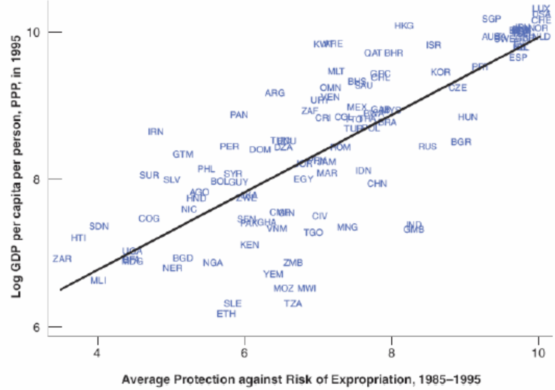
12.2 The Determinants of Technological Progress

- To sustain growth, advanced countries that are at the technology frontier must innovate.
- Most technological progress is the outcome of firms' research and development (R&D) activities.
- The level of R&D spending depends not only on the **fertility of research** (how spending on R&D translates into new ideas and new products) but also on the **appropriability of research results** (the extent to which firms can benefit from the results of their own R&D).
- **Patents** give a firm that has discovered a new product the right to exclude anyone else from the production or use of that new product for some time.

Figure 12.5 Protection from Expropriation and GDP per Person

There is a strong positive relation between the degree of protection from expropriation and the level of GDP per person.

This highlights the importance of the protection of **property rights**.

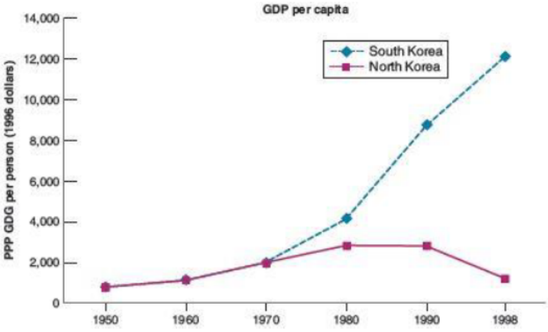


Source: Daron Acemoglu (2004). Understanding Institutions. Lionel Robbins Lectures, London School of Economics. https://economics.mit.edu/sites/default/files/publications/institutions-as-the-fundamental-cause-of-long-run-.pdf

Focus: The Importance of Institutions: North Korea and South Korea

Figure 1 PPP GDP per Person: North and South Korea, 1950-1998

After the Korean War, South Korea has provided private ownership and legal protection of private producers, while North Korea relied on central planning with no property rights for individuals.
Fifty years later, GDP per person was 10 times higher in South Korea.



Source: Daron Acemoglu (2004). Understanding Institutions. Lionel Robbins Lectures, London School of Economics. https://economics.mit.edu/sites/default/files/publications/institutions-as-the-fundamental-cause-of-long-run-.pdf

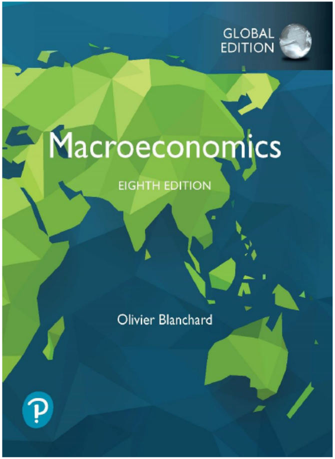
Summary

- In the steady state (balanced growth path), the growth rate of production and capital stock corresponds to the sum of the population growth rate (g_N) and the rate of technological progress (g_A).
- This growth rate of production is independent of the saving rate.
- However, the saving rate affects the steady-state level of production per effective labor.
- An increase in the saving rate temporarily pushes the growth rate above steady-state growth.

Contents

Macroeconomics

Eighth Edition, Global Edition



Pearson

Chapters 14 - 16

Expectations

Outline

Expectations

Financial Markets and Expectations

- Our focus throughout this chapter will be on the **role expectations** play in the determination of asset prices, from bonds to stocks.
- We discussed the role of expectations informally at various points in the core.
- It is now time to do it more formally.
- Not only are asset prices affected by current and expected future activity, but they in turn affect decisions that influence current economic activity.
- Understanding their determination is thus central to understanding fluctuations.

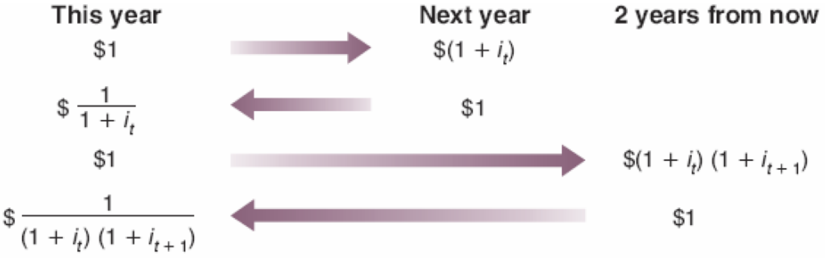
14.1 Expected Present Discounted Values (1 of 6)

- Decision: to invest or not?
- The **expected present discounted value** of a sequence of future payments is the value today of this expected sequence of payments.
- Expected present discounted values are not directly observable but must be constructed from information on the sequence of expected payments and expected interest rates.

14.1 Expected Present Discounted Values (2 of 6)

- Example: The value today of a dollar received two years from now.

Figure 14.1 Computing Present Discounted Values



14.1 Expected Present Discounted Values (3 of 6)

- $1/(1+i_t)$ is the **discount factor** with the **discount rate** i_t, which is used to compute the **present discounted value** of one dollar to be received next year.
- The higher the **nominal interest rate**, the lower the value today of a dollar received next year.
- The **present discounted value** of a sequence of payments $\$z$:

$$\$V_t = \$z_t + \frac{1}{(1+i_t)}\$z_{t+1} + \frac{1}{(1+i_t)(1+i_{t+1})}\$z_{t+2} + \dots$$

14.1 Expected Present Discounted Values (4 of 6)

- The **expected present discounted value** or **present value** of a payment $\$z$ and its expected payment $\$z^e$ in the future:

$$\$V_t = \$z_t + \frac{1}{(1+i_t)}\$z^e_{t+1} + \frac{1}{(1+i_t)(1+i^e_{t+1})}\$z^e_{t+2} + \ldots \tag{5.1}$$

- For constant interest rates i:

$$\$V_t = \$z_t + \frac{1}{(1+i)}\$z^e_{t+1} + \frac{1}{(1+i)^2}\$z^e_{t+2} + \ldots \tag{5.2}$$

- For constant interest rates and constant payments $\$z$:

$$\$V_t = \$z\left[1 + \frac{1}{(1+i)} + \ldots + \frac{1}{(1+i)^{n-1}}\right]$$

14.1 Expected Present Discounted Values (5 of 6)

- For constant interest rates and payment forever:

$$\$V_t = \frac{\$z}{i}$$

- If $i = 0$, then the present discounted value of a sequence of expected payments is just the sum of those expected payments.
- The present value of a sequence of real payments (discounted by real interest rates r_t):

$$V_t = z_t + \frac{1}{(1+r_t)} z^e_{t+1} + \frac{1}{(1+r_t)(1+r^e_{t+1})} z^e_{t+2} + \dots \qquad (5.3)$$

14.1 Expected Present Discounted Values (6 of 6)

- Two ways to compute the present value of payments:
    1. The present value of the sequence of payments expressed in dollars, discounted using nominal interest rates, and then divided by the price level today.
    2. The present value of the sequence of payments expressed in real terms, discounted using real interest rates (see Eq. (5.3)).
- Divide both sides of Eq. (5.1) by the current price (P_t):

$$\frac{\$V_t}{P_t} = \frac{\$z_t}{P_t} + \frac{1}{(1+i_t)}\frac{\$z^e_{t+1}}{P_t} + \frac{1}{(1+i_t)(1+i^e_{t+1})}\frac{\$z^e_{t+2}}{P_t} + \dots \tag{5.4}$$

14.2 Bond Prices and Bond Yields (1 of 9)

- Bonds differ in two basic dimensions:
  - **Maturity**: The length of time over which the bond promises to make payments to the holder of the bond.
  - **Risk**:
    (1) Default risk as the risk that the issuer of the bond will not pay back the full amount promised by the bond.
    (2) Price risk as the uncertainty about the price you can sell the bond for if you want to sell it in the future before maturity.

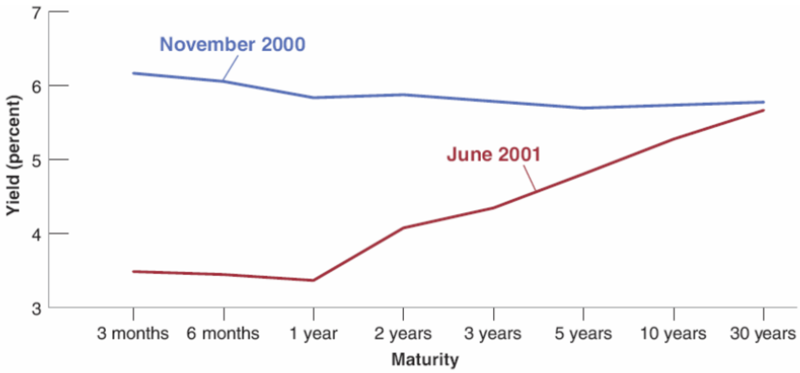
14.2 Bond Prices and Bond Yields (2 of 9)

- **Yield to maturity** or **yield**: The interest rates associated with bonds of different maturities
- **Short-term interest rates**: Yields on bonds with a short maturity, typically a year or less
- **Long-term interest rates**: Yields on bonds with a longer maturity than a year
- **Term structure of interest rates or yield curve**: The relation between maturity and yield

14.2 Bond Prices and Bond Yields (3 of 9)

Figure 14.2 U.S. Yield Curves: November 1, 2000 and June 1, 2001

The yield curve, which was slightly downward sloping in November 2000, was sharply upward sloping seven months later.



Source: FRED: Series DGS1MO, DGS3MO, DGS6MO, DGS1, DGS2, DGS3, DGS5, DGS7, DGS10, DGS20, DGS30.

Focus: The Vocabulary of Bond Markets (1 of 3)

- **Government bonds**: Bonds issued by the government
- **Corporate bonds**: Bonds issued by firms
- **Bond ratings**: ratings for default risk
- **Risk premium**: The difference between the interest rate paid on a given bond and the interest rate on the bond with the best rating
- **Junk bonds**: Bonds with high default risk
- **Discount bonds**: Bonds that promise a single payment at maturity called the **face value**

Focus: The Vocabulary of Bond Markets (2 of 3)

- **Coupon bonds**: Bonds that promise multiple payments before maturity and one payment at maturity
- **Coupon payments**: The payments before maturity
- **Coupon rate**: The ratio of the coupon payments to the face value
- **Current yield**: The ratio of the coupon payment to the price of the bond
- **Life**: The amount of time left until the bond matures
- **Treasury bills (T-bills)**: U.S. government bonds with a maturity up to a year

Focus: The Vocabulary of Bond Markets (3 of 3)

- **Treasury notes**: U.S. government bonds with a maturity of 1 to 10 years
- **Treasury bonds**: U.S. government bonds with a maturity of 10 or more years
- **Term premium**: The premium associated with longer maturities
- **Indexed bonds**: Bonds that promise payments adjusted for inflation
- **Treasury Inflation Protected Securities (TIPS)**: Indexed bonds introduced in the United States in 1997

14.2 Bond Prices and Bond Yields (4 of 9)

- The price of a one-year bond that promises to pay $100 next year:

$$\$P_{1t} = \frac{\$100}{1 + i_{1t}} \tag{5.5}$$

- The price of a two-year bond that promises to pay $100 in two years:

$$\$P_{2t} = \frac{\$100}{(1 + i_{1t})(1 + i^e_{1t+1})} \tag{5.6}$$

Figure 14.3 Returns from Holding One-Year and Two-Year Bonds for One Year

14.2 Bond Prices and Bond Yields (6 of 9)

- **Arbitrage**: The expected returns on two assets must be equal.
- **Expectations hypothesis**: Investors care only about the expected returns and do not care about risk.
- Two bonds in **Figure 14.3** must offer the same expected one-year return:

$$1 + i_{1t} = \frac{\$P^e_{1t+1}}{\$P_{2t}} \tag{5.7}$$

$$\$P_{2t} = \frac{\$P^e_{1t+1}}{1 + i_{1t}} \tag{5.8}$$

which means that the price of a two-year bond today is the present value of the expected price of the bond next year.

14.2 Bond Prices and Bond Yields (7 of 9)

- The expected price of one-year bonds next year with a payment of \$100:

$$\$P^e_{1t+1} = \frac{\$100}{1 + i^e_{1t+1}} \tag{5.9}$$

so that

$$\$P_{2t} = \frac{\$100}{(1 + i_{1t})(1 + i^e_{1t+1})} \tag{5.10}$$

which is the same as Eq. (5.6).

14.2 Bond Prices and Bond Yields (8 of 9)

- The *yield to maturity* on an n-year bond (**n-year interest rate**) is the constant annual interest rate that makes the bond price today equal to the present value of future payments on the bond.
- The yield to maturity on a two-year bond that satisfies:

$$\$P_{2t} = \frac{\$100}{(1+i_{2t})^2} \tag{5.11}$$

is

$$i_{2t} \approx \frac{1}{2}\left(i_{1t} + i^e_{1t+1}\right) \tag{5.12}$$

which means that *the two-year interest rate is (approximately) the average of the current one-year interest rate and next year's expected one-year interest rate.*

14.2 Bond Prices and Bond Yields (9 of 9)

- Eq. (5.10) with a **risk premium** x on the two-year bond:

$$\$P_{2t} = \frac{\$100}{(1+i_t)(1+i^e_{1t+1}+x)} \tag{5.13}$$

so that the two-year yield is:

$$i_{2t} \approx \frac{1}{2}\left(i_{1t} + i^e_{1t+1} + x\right) \tag{5.14}$$

which is the average of the current and expected one-year rate plus a risk premium.

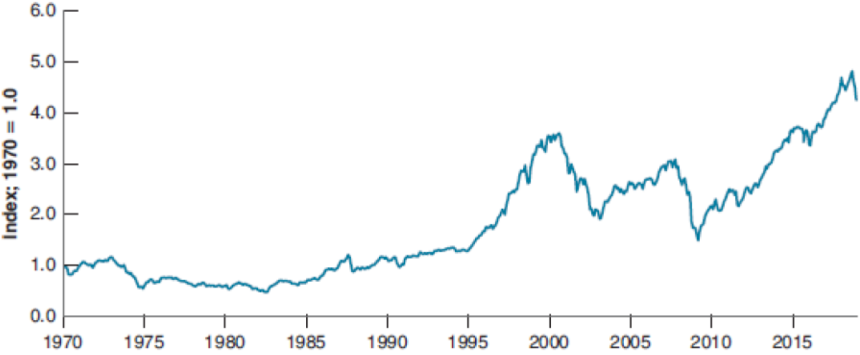
14.3 The Stock Market and Movements in Stock Prices (1 of 10)

- Firms finance themselves through:
  - **Internal finance**: Using their own earnings
  - **External finance**: Bank loans
  - **Debt finance**: Bonds and loans
  - **Equity finance**: Issuing **stocks** or **shares** that pay **dividends**

14.3 The Stock Market and Movements in Stock Prices (2 of 10)

Figure 14.4 Standard and Poor's Stock Price Index in Real Terms since 1970

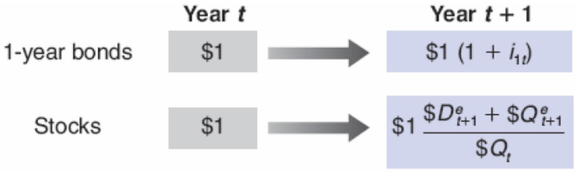
Note the sharp fluctuations in stock prices since the mid-1990s.



Source: FRED: Series SP500, CPIAUCSL.

14.3 The Stock Market and Movements in Stock Prices (3 of 10)

Figure 14.5 Returns from Holding One-Year Bonds or Stocks for One Year



- $\$Q$ is the price of the stock
- $\$D^e$ is the expected dividend
- **Ex-dividend price**: The stock price after the dividend has been paid this year

14.3 The Stock Market and Movements in Stock Prices (4 of 10)

- Equilibrium requires that the expected rate of return from holding stocks for one year (left side) be the same as the rate of return on one-year bonds plus the equity premium x (right side):

$$\frac{\$D^e_{t+1} + \$Q^e_{t+1}}{\$Q_t} = 1 + i_{1t} + x$$

or

$$\$Q_t = \frac{\$D^e_{t+1}}{(1 + i_{1t} + x)} + \frac{\$Q^e_{t+1}}{(1 + i_{1t} + x)} \qquad (5.15)$$

14.3 The Stock Market and Movements in Stock Prices (5 of 10)

- If the expected prices in n years equal the present values of the expected prices and dividends:

$$\$Q_t = \frac{\$D^e_{t+1}}{(1+i_{1t}+x)} + \frac{\$D^e_{t+2}}{(1+i_{1t}+x)(1+i^e_{1t+1}+x)} + \ldots + \frac{\$D^e_{t+n}}{(1+i_{1t}+x)\ldots(1+i^e_{1t+n-1}+x)} + \frac{\$Q^e_{t+n}}{(1+i_{1t}+x)\ldots(1+i^e_{1t+n-1}+x)} \quad (5.16)$$

- If the interest rate is positive, then it reduces to:

$$\$Q_t = \frac{\$D^e_{t+1}}{(1+i_{1t}+x)} + \frac{\$D^e_{t+2}}{(1+i_{1t}+x)(1+i^e_{1t+1}+x)} + \ldots + \frac{\$D^e_{t+n}}{(1+i_{1t}+x)\ldots(1+i^e_{1t+n-1}+x)} \quad (5.17)$$

14.3 The Stock Market and Movements in Stock Prices (6 of 10)

- Replacing the *nominal* interest rates with the *real* interest rates, then the real stock price is:

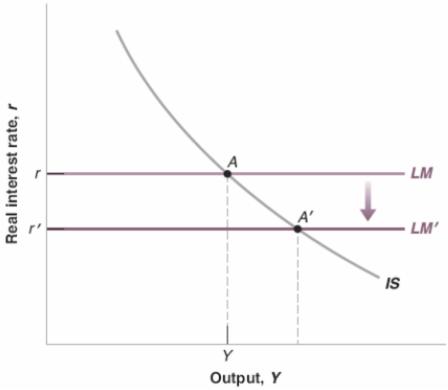
$$\$Q_t = \frac{\$D^e_{t+1}}{(1 + r_{1t} + x)} + \frac{\$D^e_{t+2}}{(1 + r_{1t} + x)(1 + r^e_{1t+1} + x)} + \ldots \qquad (5.18)$$

- Implications:
  - Higher expected future real dividends lead to a higher real stock price.
  - Higher current and expected future one-year real interest rates lead to a lower real stock price.
  - A higher equity premium leads to a lower stock price.

14.3 The Stock Market and Movements in Stock Prices (7 of 10)

Figure 14.6 An Expansionary Monetary Policy and the Stock Market

A monetary expansion decreases the interest rate and increases output. What it does to the stock market depends on whether or not financial markets **anticipated** the monetary expansion.



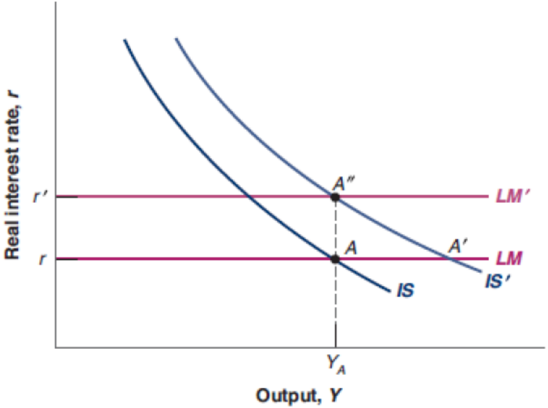
14.3 The Stock Market and Movements in Stock Prices (8 of 10)

- Three possible scenarios:
  - Stock prices may go **up**. If the Fed's move is at least partly unexpected, stock prices will increase, for two reasons: First, a more expansionary monetary policy implies lower interest rates for some time. Second, it also implies higher output for some time, and therefore higher dividends. Both lower interest rates and higher dividends – current and expected – will lead to an increase in stock prices.
  - Stock prices may **not change**, if investors fully anticipated the expansionary monetary policy.
  - Stock prices may go **down**, if stock market participants believe the Fed is acting because it knows something they don't and conclude that lower interest rates will not be enough to offset the bad news.

14.3 The Stock Market and Movements in Stock Prices (9 of 10)

Figure 14.7 An Increase in Consumption Spending and the Stock Market

An increase in consumption leads to higher level of output. What happens to the stock market depends on the reaction of the Fed.



14.3 The Stock Market and Movements in Stock Prices (10 of 10)

- Two possible scenarios:
  - Stock prices may go **up**. If the market expects that the Fed will not respond and will keep the real policy rate unchanged at r, output will increase a lot (point A'). Due to higher (expected) dividends and unchanged interest rates, stock prices will go up.
  - Stock prices may go **down**, if stock market participants believe the Fed will increase its policy rate to avoid inflation (point A''). In that case, stock prices will go down as there is no change in expected dividends, but the (expected) interest rate is higher.

Focus: Making (Some) Sense of (Apparent) Nonsense: Why the Stock Market Moved Yesterday, and Other Stories

- April 1997. **Good news on the economy, leading to an increase in stock prices**: *"Bullish investors celebrated the release of market-friendly economic data by stampeding back into stock and bond markets, pushing the Dow Jones Industrial Average to its second-largest point gain ever and putting the blue-chip index within shooting distance of a record just weeks after it was reeling."*
- December 1999. **Good news on the economy, leading to a decrease in stock prices**: *"Good economic news was bad news for stocks and worse news for bonds ... The announcement of stronger-than-expected November retail-sales numbers wasn't welcome. Economic strength creates inflation fears and sharpens the risk that the Federal Reserve will raise interest rates again."*

14.4 Risk, Bubbles, Fads, and Asset Prices

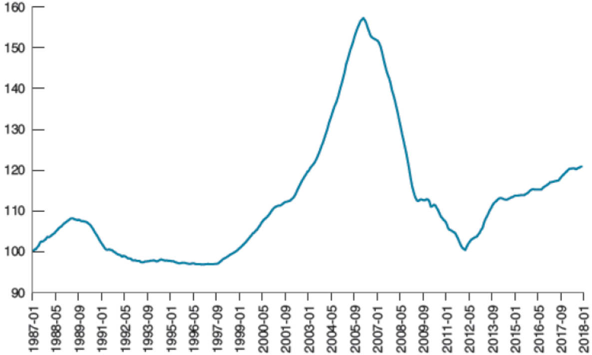
- **Risk**: Movement in stock prices comes not just from expectations of future dividends and interest rates but also from shifts in the equity premium x.
- **Fundamental value**: The present value of expected dividends given in Eq. (5.18). Stocks are sometimes *underpriced* or *overpriced*.
- **Rational speculative bubbles**: Stock prices increase just because investors expect them to. Stock prices are higher than fundamentally justified.
- **Fads**: Stocks become high priced for no reason other than its price has increased in the past, which created excessive optimism.

Focus: Famous Bubbles: From Tulipmania in 17th-Century Holland to Russia in 1994

- In 1634, a *"tulip bubble"* began to take place as the price of rare bulbs started increasing, and speculators bought tulip bulbs in anticipation of even higher prices later.
- The price of a bulb called *"Admiral Van de Eyck"* jumped from 1,500 guineas in 1634 to 7,500 guineas in 1637.
- In 1994, a Russian *"financier"* created a company called MMM and promised shareholders a rate of return of at least 3,000% a year.
- Even though MMM was not involved in any type of production and held no assets, its share prices increased from 1,600 rubles in February to 105,000 in July.
- Bitcoin: CBBTCUSD

Focus: The Increase in U.S. Housing Prices: Fundamentals or Bubble?

Figure 1 The U.S. Housing Price-to-Rent Ratio since 1987



Source: FRED: Case-Shiller Home Price Index CSUSHPISA, Rent of Primary Residence CUSR0000SEHA.

Summary (1 of 2)

- The **expected present discounted value** of a sequence of payments equals the value this year of the expected sequence of payments. Depends:
  - positively on current and future expected payments and
  - negatively on current and future expected interest rates.
- Due to **arbitrage** the price of a bond is the present value of payments on the bond.
- The **yield to maturity** is (approximately) equal to the average of current and expected short-term interest rates over the life of the bond, plus a **risk premium**.
- The **slope of the yield curve** (term structure) indicates what financial markets expect to happen to short-term interest rates in the future.

Summary (2 of 2)

- In the absence of **bubbles** and **fads**, the price of a stock is equal to its **fundamental value**. Depends positively on expected dividends and negatively on current and expected interest rates.
- Changes in output may or may not be associated with changes in stock prices. Depends on
  (1) what the market expected in the first place,
  (2) the source of the shocks, and
  (3) how the market expects the central bank to react.

Expectations, Consumption, and Investment

- In this chapter, we look at the role expectations play in determining the two main components – **consumption** and **investment**.
- This description of consumption and investment will be the main building block of the **expanded *IS*-*LM* model** we will develop in Chapter 16.

15.1 Consumption (1 of 4)

- The modern theory of consumption was developed independently in the 1950s by Milton Friedman as the **permanent theory of consumption**, and by Franco Modigliani as the **life-cycle theory of consumption**.
- Consumption for a very foresighted consumer depends on:
  - **Financial wealth**: The value of checking and saving accounts
  - **Housing wealth**: The value of the house owned minus the mortgage due
  - **Human wealth**: After-tax labor income over working life
  - **Nonhuman wealth**: The sum of financial wealth and housing wealth
  - **Total wealth** = Human wealth + Nonhuman wealth

15.1 Consumption (2 of 4)

- Consumption decision:

$$C_t = C(\text{total wealth}_t) \tag{5.19}$$

- If you want to consume the same amount every year, the constant level of consumption that you can afford equals your total wealth divided by your expected remaining life.
- However, you might:
  - not want to plan for constant consumption over your lifetime
  - make consumption decisions in a less forward-looking fashion
  - become unemployed or sick
  - not be able to get a loan from a bank when you need to borrow

15.1 Consumption (3 of 4)

- Consumption function with after-tax labor income:

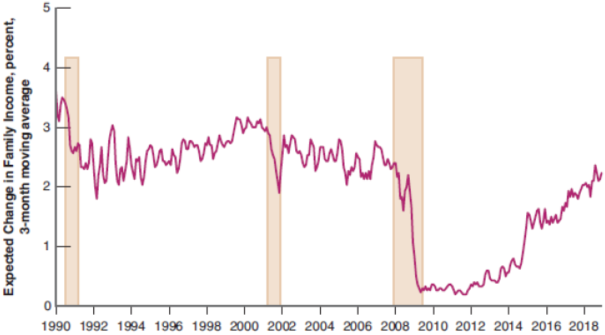
$$C_t = \underset{(+,+)}{C}(\text{total wealth}_t, Y_{Lt} - T_t) \tag{5.20}$$

- Expectations affect consumption:
  - Directly through human wealth
  - Indirectly through nonhuman wealth
- Implications of expectations for the relation between consumption and income:
  - *Consumption is likely to respond less than one-for-one to fluctuations in current income.*
  - *Consumption may move even if current income does not change.*

15.1 Consumption (4 of 4)

Figure 15.1 Expected Change in Family Income since 1990

After falling sharply in 2008 and 2009, expectations of income growth remained low for a long time.



Source: FRED: Survey of Consumers, Table 14, University of Michigan. The shaded areas represent recessions.

15.2 Investment (1 of 6)

- To compute the present value of expected profits, the firm must first estimate how long the machine will last or the depreciation rate δ.
- The *present value of expected profits* from buying the machine in year t is:

$$V\left(\Pi_t^e\right) = \frac{1}{(1+r_t)}\Pi_{t+1}^e + \frac{1}{(1+r_t)(1+r_{t+1}^e)}(1-\delta)\Pi_{t+2}^e + \ldots \qquad (5.21)$$

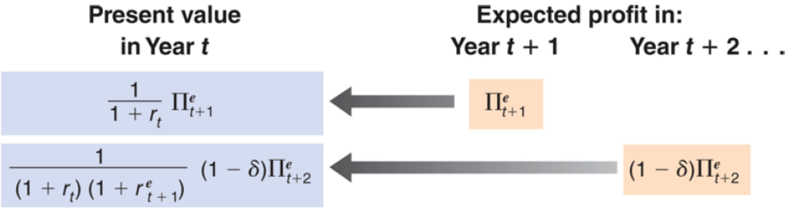
where Π_{t+1}^e denotes expected profit in $t+1$

- The investment function becomes:

$$I_t = I\left[V\left(\underset{(+)}{\Pi_t^e}\right)\right] \qquad (5.22)$$

15.2 Investment (2 of 6)

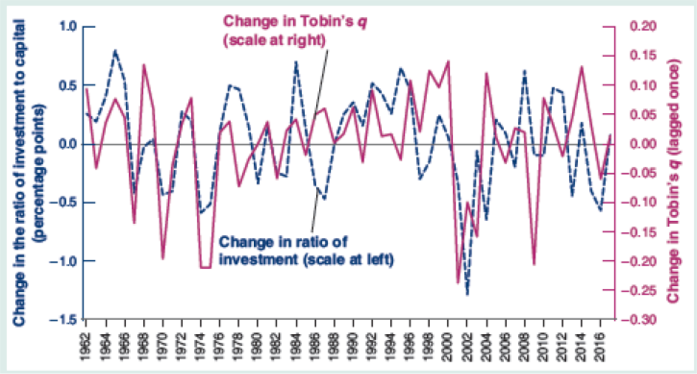
Figure 15.2 Computing the Present Value of Expected Profits



- Firms might not need to go through this type of computations as the **stock price** tells them how much the stock market values each unit of capital already in place.
- If the stock market value exceeds the purchase price of an additional unit of capital, the firm should invest, otherwise, it should not.

Focus: Investment and the Stock Market

Figure 1 Tobin's q versus the Ratio of Investment to Capital. Annual Rates of Change since 1962



Source: Flow of Funds, Table s5a. Numerator of q: Market value of equity + Debt + Loans – Financial Assets, nonfinancial US corporations. Denominator of q: Nonfinancial assets of nonfinancial US corporations.

15.2 Investment (3 of 6)

- Assume **static expectations**:

$$\Pi^e_{t+1} = \Pi^e_{t+2} = \ldots = \Pi_t$$

$$r^e_{t+1} = r^e_{t+2} = \ldots = r_t$$

so that Eq. (5.21) becomes:

$$V\left(\Pi^e_t\right) = \frac{\Pi_t}{r_t + \delta} \tag{5.23}$$

- Replacing Eq. (5.23) in Eq. (5.22) gives:

$$I_t = I\left(\frac{\Pi_t}{r_t + \delta}\right) \tag{5.24}$$

where $(r_t + \delta)$ is **rental cost** (user cost), or shadow cost of capital.

APPENDIX: Derivation of the Expected Present Value of Profits under Static Expectations

- If firms expect both future profits and future interest rates to remain at the same level as today, then Eq. (5.21) becomes:

$$V\left(\Pi_t^e\right) = \frac{1}{(1+r_t)}\Pi_t + \frac{1}{(1+r_t)^2}(1-\delta)\Pi_t + \ldots$$

or

$$V\left(\Pi_t^e\right) = \frac{1}{1+r_t}\Pi_t\left(1 + \frac{1-\delta}{1+r_t} + \ldots\right) \tag{5.25}$$

which can be reduced to

$$V\left(\Pi_t^e\right) = \frac{1}{1+r_t}\frac{1+r_t}{r_t+\delta}\Pi_t$$

which can be further simplified to produce Eq. (5.23).

15.2 Investment (4 of 6)

- According to the investment function of Eq. (5.24):
  - *Investment depends on the ratio of profit to the user cost.*
  - *The higher the profit, the higher the level of investment.*
  - *The higher the user cost, the lower the level of investment.*
- If a firm's current profit is low:
  - it can get the funds it needs only by borrowing if it wants to buy new machines.
  - it might have difficulty borrowing even if it wants to invest.

15.2 Investment (5 of 6)

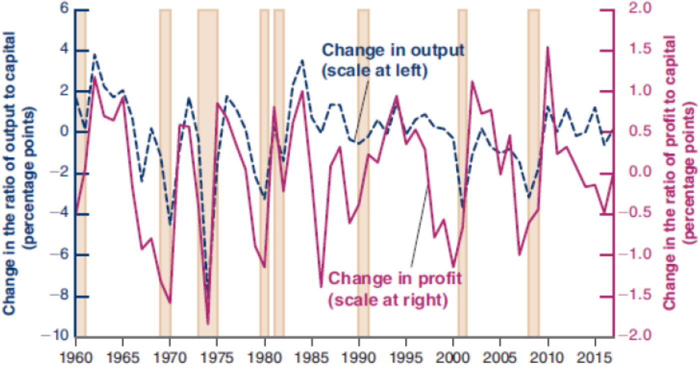
- Investment depends both on the expected present value of future profits and on the current level of profit:

$$I_t = I\left[\underset{(+,+)}{V\left(\Pi_t^e\right), \Pi_t}\right] \tag{5.26}$$

- Profit per unit of capital is an increasing function of the ratio of sales or output (Y) to the capital stock (K):

$$\Pi_t = \Pi\left(\underset{(+)}{\frac{Y_t}{K_t}}\right) \tag{5.27}$$

Figure 15.4 Changes in Profit per Unit of Capital versus Changes in the Ratio of Output to Capital in the United States since 1960



Source: Capital stock: BEA Fixed Assets Tables. Net stock of private nonresidential fixed assets, nonfinancial assets; Profit: BEA, NIPA Table 1.14, net operating surplus minus taxes minus transfers minus net interest and miscellaneous payments; Output: BEA, Gross value added of nonfinancial corporate business sector.

15.3 The Volatility of Consumption and Investment (1 of 3)

- Similarities between consumption and investment behavior:
  - The more transitory consumers expect a current increase in income to be, the less they will increase their consumption.
  - The more transitory firms expect a current increase in sales to be, the less they revise their assessment of the present value of profits, and thus the less likely they are to buy new machines or build new factories.

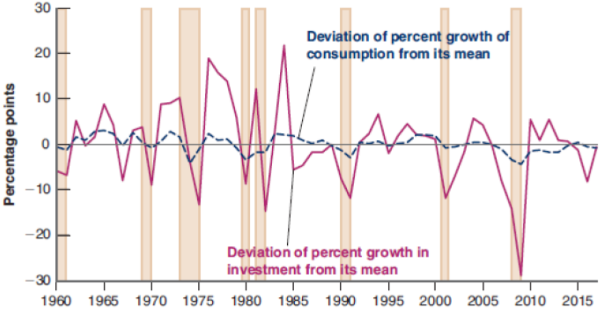
15.3 The Volatility of Consumption and Investment (2 of 3)

- Differences between consumption and investment decisions:
  - The permanent nature of the change in income implies that consumers can afford to change consumption now and in the future by the same amount as the change in income.
  - However, the change in investment spending may exceed the change in sales.

15.3 The Volatility of Consumption and Investment (3 of 3)

- Consumption and investment usually move together.
- Investment is much more volatile than consumption.
- Both components contribute roughly equal to output fluctuations.

Figure 15.5 Rates of Change in Consumption and Investment in the United States since 1960



Source: FRED: Series PCECC96, GPDI.

Summary

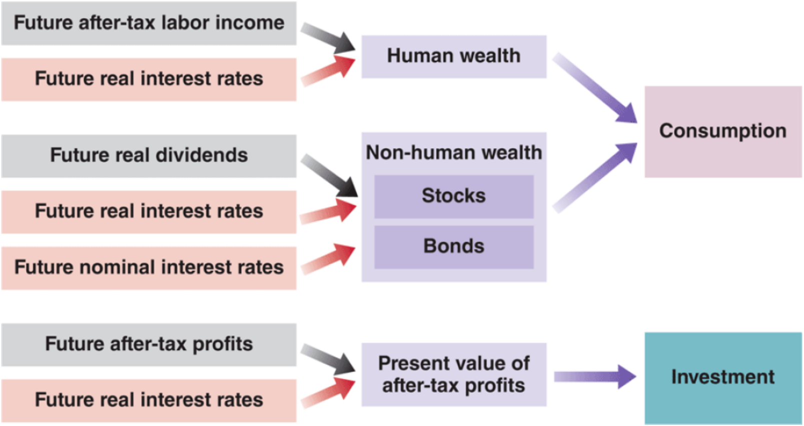
- **Consumption** depends on both wealth (human + nonhuman) and current income. The response of consumption to income depends on whether consumers perceive changes as transitory or permanent.
- **Investment** depends on both current profits and the present value of expected future profits. Movements in profits are closely related to movements in output. Therefore, investment depends indirectly on current and expected future output movements.
- Investment is much more volatile than consumption. But because investments accounts only for 15% of GDP and consumption for 70%, movements in both are of roughly equal importance in accounting for movements in output.

Expectations, Output, and Policy

- In Chapter 14, we saw how expectations affected asset prices, from bonds to stocks.
- In Chapter 15, we saw how expectations affected consumption decisions and investment decisions.
- In this chapter, we put those pieces together and take another look at the effects of monetary and fiscal policy.

16.1 Expectations and Decisions: Taking Stock (1 of 5)

Figure 16.1 Expectations and Private Spending: The Channels



16.1 Expectations and Decisions: Taking Stock (2 of 5)

- Recall Chapter 6, the *IS* relation:

$$Y = C(Y - T) + I(Y, r + x) + G$$

- Assume **(aggregate) private spending** (A), equals the sum of consumption and investment spending:

$$A(Y, T, r, x) \equiv C(Y - T) + I(Y, r + x)$$

so the *IS* relation becomes:

$$Y = \underset{(+,-,-,-)}{A(Y, T, r, x)} + G \qquad (5.28)$$

16.1 Expectations and Decisions: Taking Stock (3 of 5)

- Let primes denote future values and the superscript e denote an expectation, so

$$Y = \underset{(+,-,-,+,-,-)}{A(Y, T, r, Y'^e, T'^e, r'^e)} + G \tag{5.29}$$

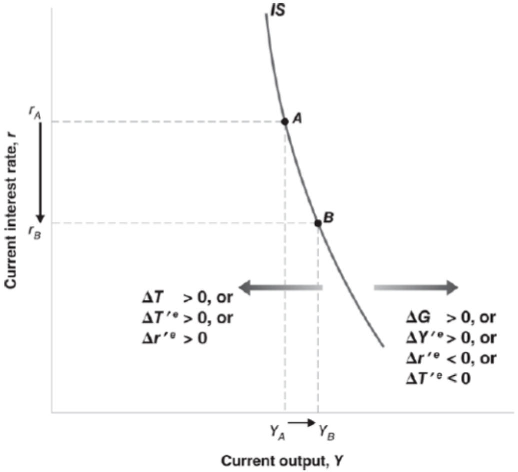
which means that

$$\begin{array}{lllll} Y & \text{or} & Y'^e & \text{increase} \Rightarrow A & \text{increases} \\ T & \text{or} & T'^e & \text{increase} \Rightarrow A & \text{decreases} \\ r & \text{or} & r'^e & \text{increase} \Rightarrow A & \text{decreases} \end{array}$$

- Here we ignore the risk premium x for simplicity.

Figure 16.2 The New *IS* Curve

Given expectations, a decrease in the real policy rate leads to a small increase in output. The *IS* curve is steeply downward sloping. Increases in government spending, or in expected future output, shift the *IS* curve to the right. Increases in taxes, in expected future taxes, or in the expected future real policy rate shift the *IS* curve to the left.



16.1 Expectations and Decisions: Taking Stock (5 of 5)

- The new *IS* curve is much steeper than the *IS* curve in previous chapters, so a decrease in the current policy rate is likely to have only a small effect on equilibrium output.
- A decrease in the current real policy rate, *given unchanged expectations of the future real policy rate*, does not have much effect on private spending.
- The multiplier is likely to be small because a change in current income, given unchanged expectations of future income, is unlikely to have a large effect on spending.

16.2 Monetary Policy, Expectations, and Output (1 of 3)

- The Fed affects directly the *current real interest rate* (r), so the LM curve is a horizontal line at $\bar{r}$:

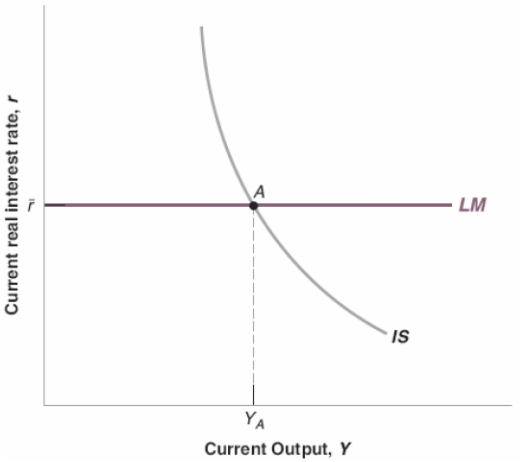
$$IS: \quad Y = A(Y, T, r, Y'^e, T'^e, r'^e) + G \tag{5.30}$$

$$LM: \quad r = \bar{r} \tag{5.31}$$

- The effects of monetary policy depend on its effects on expectations:
  - If a monetary expansion leads to changes in expectations of future interest rates and output, then the policy effect on output may be large.
  - But if expectations remain unchanged, the policy effects on output will be limited.

Figure 16.3 The New *IS-LM*

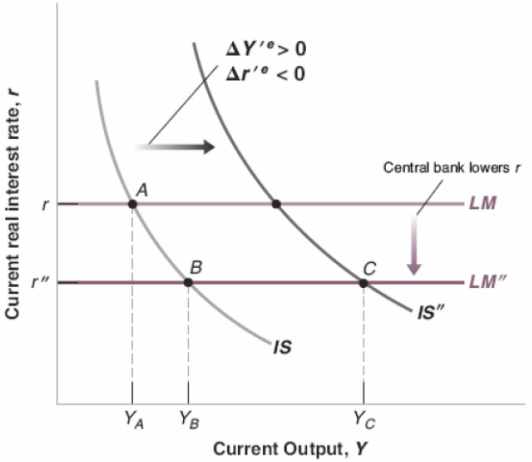
The *IS* curve is steeply downward sloping. Other things being equal, a change in the current interest rate has a small effect on output. Given the current real interest rate set by the central bank, $\bar{r}$, the equilibrium is at point A.



16.2 Monetary Policy, Expectations, and Output (3 of 3)

Figure 16.4 The Effects of an Expansionary Monetary Policy

The effects of monetary policy on output depend very much on whether and how monetary policy affects expectations.

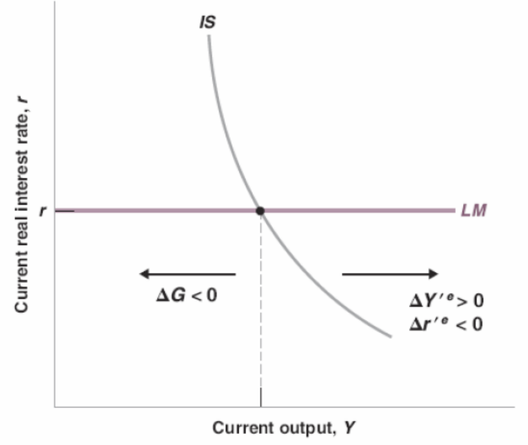


Focus: Rational Expectations

- **Rational expectations**: Expectations formed in a forward-looking manner.
- The last 40 years in macroeconomic research are often called the *"rational expectations revolution"*.
- Expectations were referred to as **animal spirits** by Keynes in the *General Theory*.
- Economists have also assumed that people form **static expectations** (people expect the future to be like the present), and **adaptive expectations** (people *"adapt"* by revising their expectations over time).
- In the early 1970s, Robert Lucas and Thomas Sargent argued that people have rational expectations as they look into the future and do the best job they can in predicting it.

Figure 16.5 The Effects of a Deficit Reduction on Current Output

When account is taken of its effect on expectations, the decrease in government spending need not lead to a decrease in output.



16.3 Deficit Reduction, Expectations, and Output (2 of 7)

- The net effect of the three shifts in the *IS* curve depends on:

1. Timing
   - Credibly **backloading** the deficit reduction program toward the future, with small cuts today and larger cuts in the future, is more likely to lead to an increase in output.
   - The program's **credibility** (the perceived probability that the government will do what it has promised when the time comes to it) decreases when the government announces the need for painful cuts in spending, and then leaving them to the future.

16.3 Deficit Reduction, Expectations, and Output (3 of 7)

- The net effect of the three shifts in the *IS* curve depends on:

  2. Composition

     - If some government spending programs are perceived as "wasteful", cutting these programs today will allow the government to cut taxes in the future.
     - Expectations of lower future taxes and lower distortions could induce firms to invest today, thus raising output in the short run.

16.3 Deficit Reduction, Expectations, and Output (4 of 7)

- The net effect of the three shifts in the *IS* curve depends on:

  3. The Initial Situation

     - If government debt is increasing fast, then a credible deficit reduction program is more likely to increase output in the short run, as the program announcement may well reassure the people that the government has regained control of its budget.

16.3 Deficit Reduction, Expectations, and Output (5 of 7)

- The net effect of the three shifts in the *IS* curve depends on:

  4. Monetary Policy

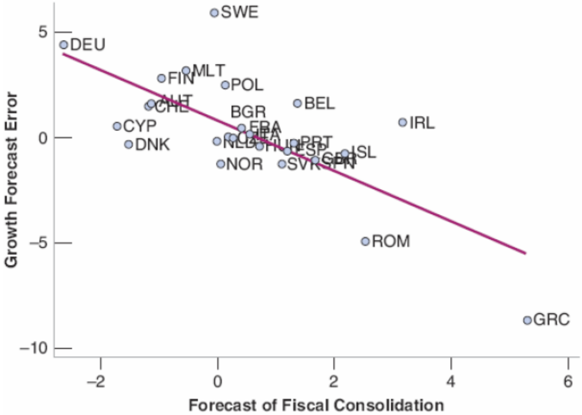
     - Even if monetary policy cannot fully offset the effect of an adverse shift in the *IS* curve, a decrease in the policy rate can help reduce the adverse effects of the shift on output.

16.3 Deficit Reduction, Expectations, and Output (6 of 7)

- Views about the **fiscal multipliers** (the net effect of fiscal consolidation once direct and expectation effects are taken into account):
  - Those in favor of strong fiscal consolidation argue that fiscal multipliers are likely to be **negative**, and thus smaller deficits would lead to an increase in output.
  - Those against strong fiscal consolidation argue that fiscal multipliers are likely to be **positive** and possibly large, thus smaller deficits would lead to a decrease in output.

Figure 16.6 Growth Forecast Errors and Fiscal Consolidation in Europe, 2010-2011

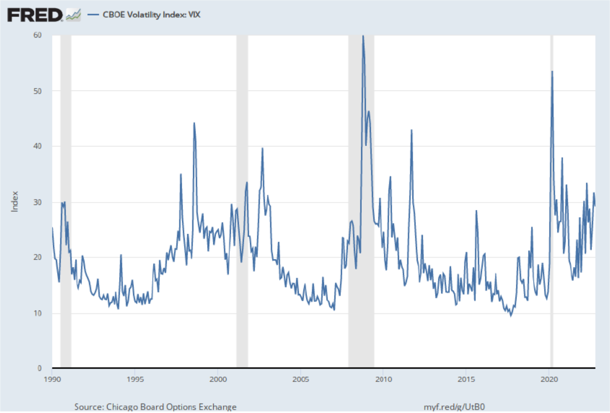
European countries with stronger fiscal consolidations in 2010 and 2011 had larger negative growth forecast errors.



Focus: Uncertainty and Fluctuations (1 of 2)

Figure 1 The Evolution of the VIX

The VIX is constructed by aggregating the information on prices of options on buying or selling stocks at a given price in the future and gives a sense of the uncertainty in the market at a given point in time.

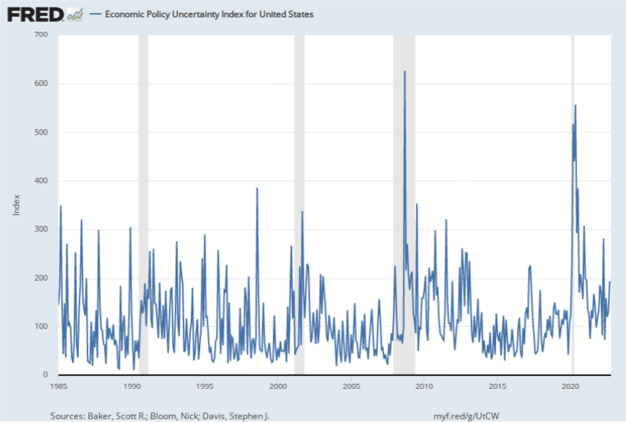


Source: FRED: VIXCLS

Focus: Uncertainty and Fluctuations (2 of 2)

Figure 2 The Evolution of the EPU

The EPU is constructed by aggregating the information on newspaper coverage of specific word combinations and gives a sense of the uncertainty in the media at a given point in time.



Source: FRED: USEPUINDXD

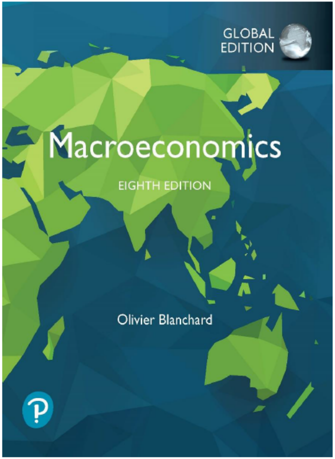
Summary

- Private spending in the goods market depends on current and expected future output and on current and expected real interest rates.
- Changes in expected future output or in the expected future real interest rate lead to changes in spending and in output today.
- The effects of fiscal and monetary policy on spending and output depend on how the policy affects expectations of future output and real interest rates. If a change in policy has already been expected, it does not change expectations of future output and real interest rates.
- Rational expectations: People, firms and financial markets form expectations of the future by assessing the course of future expected policy.

Contents

Macroeconomics

Eighth Edition, Global Edition



Pearson

Chapters 17 - 20

The Open Economy

Outline

The Open Economy

Openness in Goods and Financial Markets (1 of 3)

- **Openness in goods markets**:
  - The ability of consumers and firms to choose between domestic goods and foreign goods.
  - Even countries most committed to free trade have **tariffs** (taxes on imported goods) and **quotas** (restrictions on the quantity of goods that can be imported).
- **Openness in financial markets**:
  - The ability of financial investors to choose between domestic assets and foreign assets.
  - Until recently, even some rich countries had **capital controls** – restrictions on the foreign assets that domestic residents could hold and the domestic assets foreign residents could hold.

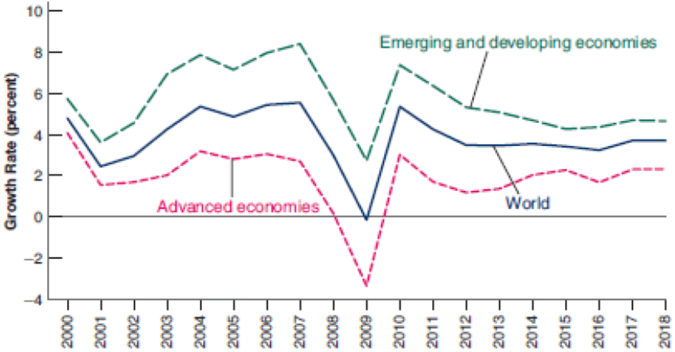
Openness in Goods and Financial Markets (2 of 3)

- **Openness in factor markets**:
  - The ability of firms to choose where to locate production, and of workers to choose where to work.
  - E.g., the **North American Free Trade Agreement (NAFTA)** or the **European Union**.

Openness in Goods and Financial Markets (3 of 3)

Figure 17.1 Growth in Advanced and Emerging Economies since 2000

The crisis started in the United States, but it affected nearly every country in the world.

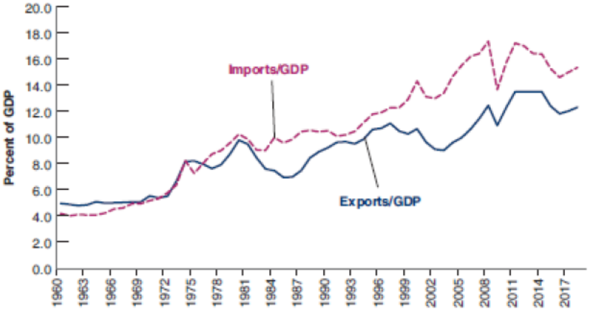


Source: IMF, World Economic Outlook, October 2015.

17.1 Openness in Goods Markets (1 of 11)

Figure 17.2 U.S. Exports and Imports as Ratios of GDP since 1960

Since 1960, exports and imports have more than tripled in relation to GDP. The United States has become a much more open economy.



Source: FRED: Series EXPGS, IMPGS, GDP.

17.1 Openness in Goods Markets (2 of 11)

- The United States is at the low end of the range of export ratios.

Table 17.1 Ratios of Exports to GDP for Selected OECD Countries, 2017

Country	Export Ratio	Country	Export Ratio
United States	12.3%	Germany	47.2%
Japan	16.1%	Austria	53.9%
United Kingdom	28.7%	Switzerland	65.0%
Chile	30.5%	Netherlands	86.4%

Source: IMF, World Economic Outlook.

Focus: Can Exports Exceed GDP?

- Since a country cannot export more than it produces, will the export ratio always be less than one?
- No, exports may be larger than GDP because exports and imports may include exports and imports of intermediate goods.
- In 2017, the ratio of exports to GDP in Singapore was 173%!

17.1 Openness in Goods Markets (3 of 11)

- The volume of trade is not necessarily a good measure of openness.
- **Tradable goods**: Goods that compete with foreign goods in either domestic markets or foreign markets.
- Tradable goods represent about 60% of aggregate output in the United States today.

17.1 Openness in Goods Markets (4 of 11)

- **Real exchange rate**: The price of domestic goods relative to foreign goods.
- **Nominal exchange rate**: The price of the domestic currency in terms of foreign currency.
- (Nominal) **appreciation**: An increase in the price of the domestic currency in terms of a foreign currency, i.e., an increase in the exchange rate.
- (Nominal) **depreciation**: A decrease in the price of the domestic currency in terms of a foreign currency, i.e., a decrease in the exchange rate.

17.1 Openness in Goods Markets (5 of 11)

- **Fixed exchange rates**: A system in which two or more countries maintain a constant exchange rate between their currencies.
- In the fixed exchange rate system, **revaluations** are increases in the exchange rate, and **devaluations** are decreases in the exchange rate.

17.1 Openness in Goods Markets (6 of 11)

Figure 17.3 The Nominal Exchange Rate between the Dollar and the Pound since 1971

Although the dollar has appreciated relative to the pound over the past four decades, this appreciation has come with large swings in the nominal exchange rate between the two currencies.

Source: FRED: DEXUSUK.

17.1 Openness in Goods Markets (7 of 11)

- The real exchange rate, the price of U.S. goods in terms of British goods, is

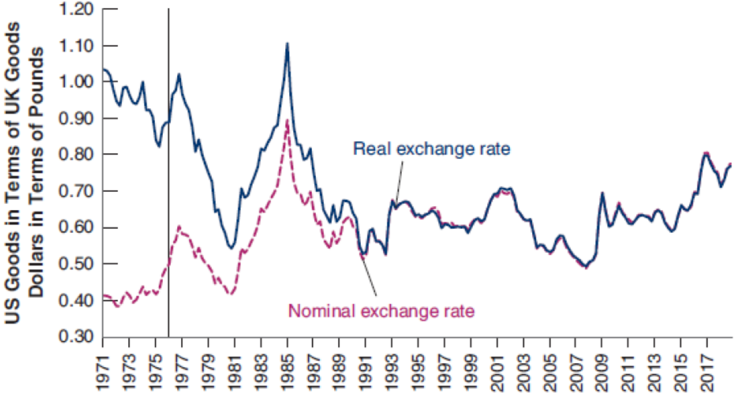
$$\varepsilon = \frac{EP}{P*} \tag{6.1}$$

Figure 17.4 The Construction of the Real Exchange Rate

- **Real appreciation**: An increase in the real exchange rate, i.e., an increase in the relative price of domestic goods in terms of foreign goods.
- **Real depreciation**: A decrease in the real exchange rate, i.e., a decrease in the relative price of domestic goods in terms of foreign goods.

17.1 Openness in Goods Markets (9 of 11)

Figure 17.5 Real and Nominal Exchange Rates between the United States and the United Kingdom since 1971



Source: FRED: GDPDEF, GBRGDPDEFQISMEI, DEXUSUK.

17.1 Openness in Goods Markets (10 of 11)

- Example of going from **bilateral exchange rates** (two countries) to **multilateral exchange rates**: The **multilateral real U.S. exchange rate** (or U.S. real exchange rate) requires data on the geographic composition of U.S. trade for both exports and imports.

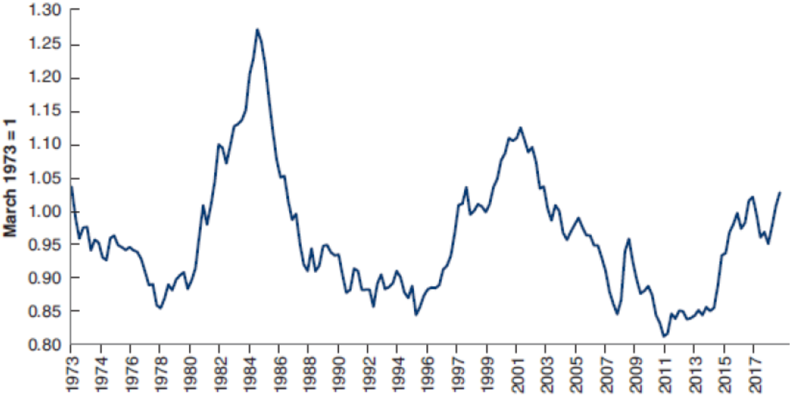
Table 17.2 Country Composition of U.S. Exports and Imports, 2018

	Percent of Exports to	Percent of Imports from
Canada	18	12
Mexico	16	14
European Union	19	19
China	7	21
Japan	4	6
Rest of Asia and Pacific	15	9
Others	21	19

Source: US Census, International Trade Data, FT900, Exhibit 14.

Figure 17.6 The U.S. Multilateral Real Exchange Rate, since 1973

Since 1973 there have been two large real appreciations of the U.S. dollar and two large real depreciations.



Source: FRED: TWEXBPA or RTWEXBGS.

17.2 Openness in Financial Markets (1 of 9)

- **Foreign exchange**: Buying and selling foreign currency
- **Balance of payments**: A set of accounts that summarize a country's transactions with the rest of the world
- **Current account**: Transactions **above the line** record payments to and from the rest of the world.
  - Exports and imports of goods and services (**trade balance**)
  - **Net income balance** between income received from the rest of the world and income paid to foreigners

17.2 Openness in Financial Markets (2 of 9)

Table 17.3 The U.S. Balance of Payments, 2018, in Billions of U.S. Dollars

Current Account		
Exports	2,500	
Imports	3,122	
Trade balance (deficit = minus sign) (1)		− 622
Income received	1,200	
Income paid	1,067	
Net income (2)		133
Current account balance (1) + (2) (deficit = minus sign)		-489
Financial Account		
Net capital transfers (3)	9	
Increase in foreign holdings of US assets (4)	811	
Increase in US holdings of foreign assets (5)	301	
Financial account balance (7) = (3) + (4) − (5)		519
Statistical discrepancy financial account − current account balance		30

Source: US Bureau of Economic Analysis, US International Transactions, Table. 17.1.

17.2 Openness in Financial Markets (3 of 9)

- **Current account balance**: The sum of net payments to and from the rest of the world
- **Current account surplus**: Positive net payments from the rest of the world
- **Current account deficit**: Negative net payments from the rest of the world

17.2 Openness in Financial Markets (4 of 9)

- **Financial account**: Transactions **below the line** record net foreign holdings of domestic assets.
- **Net capital transfers**: The difference in foreign aid given and received
- **Net capital flows** or **financial account balance**: An increase in net foreign indebtedness (holdings of domestic assets minus the increase in domestic holdings of foreign assets)
- **Financial account surplus**: Positive net capital flows
- **Financial account deficit**: Negative net capital flows
- **Statistical discrepancy**: Difference between current and capital account transactions

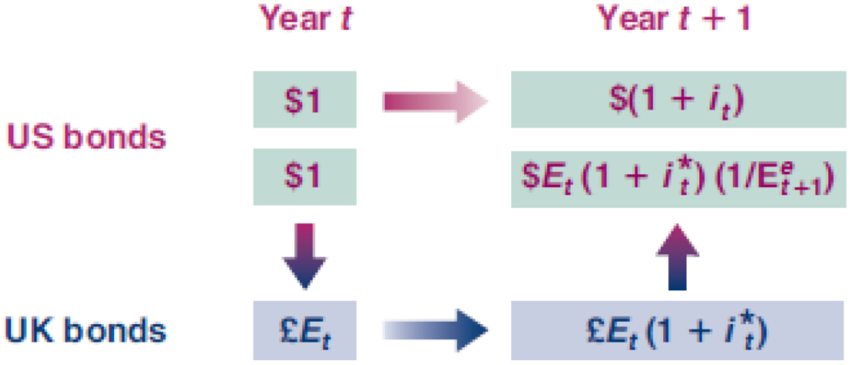
17.2 Openness in Financial Markets (5 of 9)

- GDP measures value added domestically.
- **Gross national product (GNP)** measures the value added by domestic factors of production

$$\text{GNP} = \text{GDP} + \text{NI}$$

where NI denotes net income – payments received from the rest of the world less income paid to the rest of the world.

Figure 17.7 Expected Returns from Holding One-Year US Bonds versus One-Year UK Bonds



17.2 Openness in Financial Markets (7 of 9)

- Arbitrage implies that:

$$(1 + i_t) = (E_t)(1 + i_t^*)\left(\frac{1}{E_{t+1}^e}\right)$$

or

$$(1 + i_t) = (1 + i_t^*)\left(\frac{E_t}{E_{t+1}^e}\right) \tag{6.2}$$

which is called the **uncovered interest parity** relation or the *interest parity condition*.

- The assumption that financial investors hold only the bonds with the highest expected rate of return ignores **transactions costs** and **risk**.

17.2 Openness in Financial Markets (8 of 9)

- Eq. (6.2) implies:

$$(1+i_t) = \frac{(1+i_t^*)}{\left[1+\frac{(E^e_{t+1}-E_t)}{E_t}\right]} \tag{6.3}$$

  which gives a good approximation of the **interest parity condition**:

$$i_t \approx i_t^* - \frac{E^e_{t+1}-E_t}{E_t} \tag{6.4}$$

- Arbitrage by investors implies that the *domestic interest rate must be equal to the foreign interest rate minus the expected appreciation rate of the domestic currency.*

Focus: Buying Brazilian Bonds

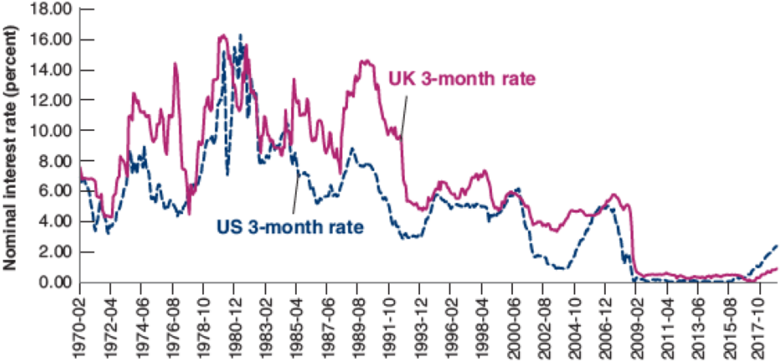
- In September 1993 Brazilian bonds were paying a monthly interest rate of 36.9% while US bonds paid 0.2% monthly.
- However, the Brazilian currency (cruzeiro) was depreciating rapidly. It fell 34.6% in August 1993 versus the dollar.
- When you factor in the currency movements the expected rate of return in dollars from holding Brazilian bonds

$$i_t = \frac{(1 + i_t^*)}{\left[1 + \frac{(E_{t+1}^e - E_t)}{E_t}\right]} - 1 = \frac{1.369}{1.346} - 1 = 1.017 - 1$$

is only 1.7% per month.

- While this return is still higher you need to consider risk and transaction costs.

Figure 17.8 Three-Month Nominal Interest Rates in the United States and United Kingdom since 1970



Source: FRED: TB3MS, IR3TTS01GBM156N.

17.3 Conclusions and a Look Ahead

- **Openness in goods markets** allows people and firms to choose between domestic goods and foreign goods.
  - This choice depends primarily on the **real exchange rate**.
- **Openness in financial markets** allows investors to choose between domestic assets and foreign assets.
  - This choice depends primarily on their **relative rates of return**, and on the **expected rate of appreciation** of the domestic currency.

The Goods Market in an Open Economy

- The U.S. recession in 2009 led to a world recession.
- To understand what happened, we must expand the treatment of the goods market in Chapter 3 of the core and account for **openness** in the analysis of goods markets.
- This is what we do in this chapter.

18.1 The *IS* Relation in the Open Economy (1 of 4)

- In an open economy, the **demand for domestic goods** is

$$Z = C + I + G - \frac{IM}{\varepsilon} + X \tag{6.5}$$

where C, I, and G constitute the total **domestic demand for goods**:

$$\text{Domestic demand: } C + I + G = C(\underset{(+)}{Y - T}) + I(\underset{(+,-)}{Y, r}) + G$$

18.1 The *IS* Relation in the Open Economy (2 of 4)

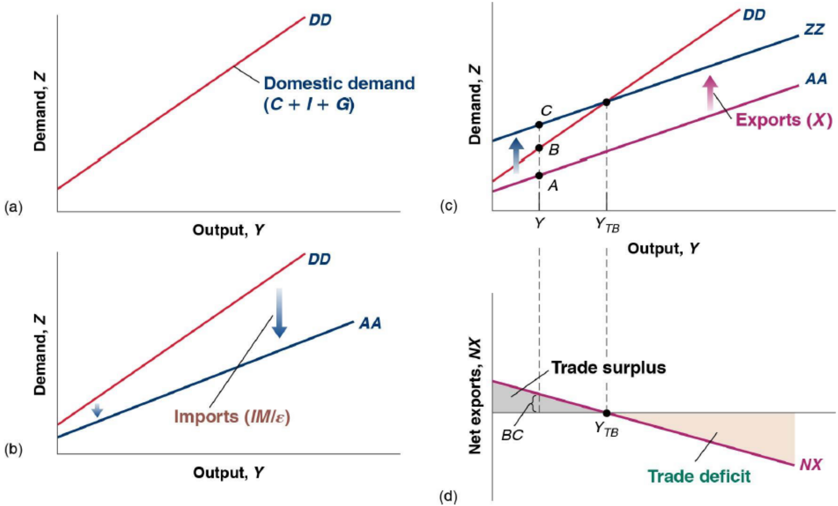
- **Imports** are positively related to domestic income (Y) and the real exchange rate (ε):

$$IM = IM(\underset{(+,+)}{Y, \varepsilon}) \tag{6.6}$$

- **Exports** are positively related to foreign income (Y^*) and negatively related to (ε):

$$X = X(\underset{(+,-)}{Y^*, \varepsilon}) \tag{6.7}$$

Figure 18.1 The Demand for Domestic Goods and Net Exports



18.1 The *IS* Relation in the Open Economy (4 of 4)

- The line *AA* represents the domestic demand for domestic goods, and the line *DD* represents domestic demand.
- *AA* is flatter than *DD*.
- As long as some of the additional demand falls on domestic goods, *AA* has positive slope.
- The line *ZZ* represents the demand for domestic goods (including exports).
- The distance between *ZZ* and *AA* is constant because exports do not depend on domestic income but they depend on foreign income.

18.2 Equilibrium Output and the Trade Balance (1 of 2)

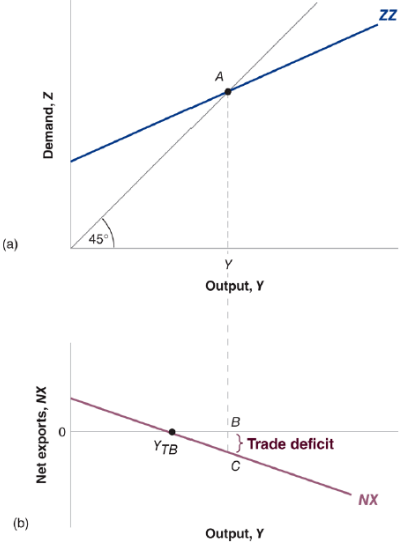
- Because $Y = Z$, the equilibrium condition for output can be expressed as:

$$Y = C(Y - T) + I(Y, r) + G - \frac{IM(Y, \varepsilon)}{\varepsilon} + X(Y^*, \varepsilon) \qquad (6.8)$$

- Graphically, equilibrium output is at the point where demand equals output, the intersection of ZZ and the 45-degree line.

Figure 18.2 Equilibrium Output and Net Exports

The goods market is in equilibrium when domestic output is equal to the demand for domestic goods. At the equilibrium level of output, the trade balance may show a deficit or a surplus.

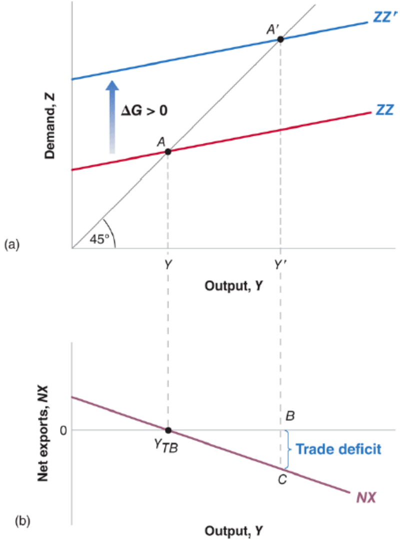


18.3 Increases in Demand – Domestic or Foreign (1 of 4)

- Differences with a closed economy:
  - Effect on trade balance: An increase in output worsens the *trade balance* (towards a *trade deficit*).
  - Smaller effect of government spending on output: Because ZZ is flatter than DD, the *multiplier is smaller in the open economy*.
  - Both effects have the same origin: Some domestic demand falls on *foreign goods*.
  - Depends on the share of imports in domestic demand.

18.3 Increases in Demand – Domestic or Foreign (2 of 4)

Figure 18.3 The Effects of an Increase in Government Spending

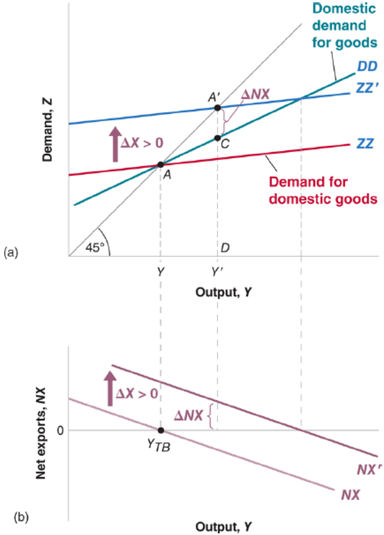


An increase in government spending leads to an increase in output and to a trade deficit.

18.3 Increases in Demand – Domestic or Foreign (3 of 4)

Figure 18.4 The Effects of an Increase in Foreign Demand

An increase in foreign demand leads to an increase in output and to a trade surplus. Trade balance (ΔNX) = demand for domestic goods (ZZ) – domestic demand for goods (DD)



18.3 Increases in Demand – Domestic or Foreign (4 of 4)

- **Summary:**
  - An increase in domestic demand leads to an increase in domestic output but leads also to a deterioration of the trade balance.
  - An increase in foreign demand leads to an increase in domestic output and an improvement in the trade balance.
- **Implications:**
  - Shocks to demand in one country affect all other countries.
  - Economic interactions complicate the task of policymakers. **Policy coordination** is not so easy to achieve (incentives to not deliver).

Focus: The G20 and the 2009 Fiscal Stimulus

- The **G20** was created in 1999 and is a group of leaders from 20 advanced and emerging countries.
- In November 2008, the G20 leaders met to coordinate their responses to the existing crisis in terms of both monetary and fiscal policies.
- Over the next few months, most countries indeed adopted discretionary measures, aimed at either increasing private or public spending.

18.4 Depreciation, the Trade Balance, and Output (1 of 4)

- Recall the **real exchange rate** (price of domestic goods in terms of foreign goods) equation (see Eq. (6.1)):

$$\varepsilon = \frac{EP}{P*}$$

and the definition of **net exports**:

$$NX = X - \frac{IM}{\varepsilon}$$

- Given the expressions from Eqs. (6.6) and (6.7):

$$NX = X(Y^*, \varepsilon) - \frac{IM(Y, \varepsilon)}{\varepsilon}$$

18.4 Depreciation, the Trade Balance, and Output (2 of 4)

- **Real depreciation** (decrease of ε) affects the trade balance through three separate channels:
  - Exports, X, increase.
  - Imports, IM, decrease.
  - The relative price of foreign goods in terms of domestic goods, $1/\varepsilon$, increases.
- **Marshall-Lerner condition**: A real depreciation leads to an increase in net exports.
- Depreciation leads to a shift in demand, both foreign and domestic, toward domestic goods. The shift in demand leads, in turn, to both an increase in domestic output and an improvement in their trade balance (same as in **Figure 18.4**).

APPENDIX: Derivation of the Marshall-Lerner Condition

- The **Marshall-Lerner condition** is the condition under which a real depreciation (lower ε) leads to an increase in net exports.
- Given the definition of net exports: $NX = X - IM/\varepsilon$
- Multiply both sides by ε to get: $\varepsilon NX = \varepsilon X - IM$, which can be written as: $\varepsilon(\Delta NX) = (\Delta\varepsilon)X + \varepsilon(\Delta X) - (\Delta IM)$
- Divide both sides by εX to get:

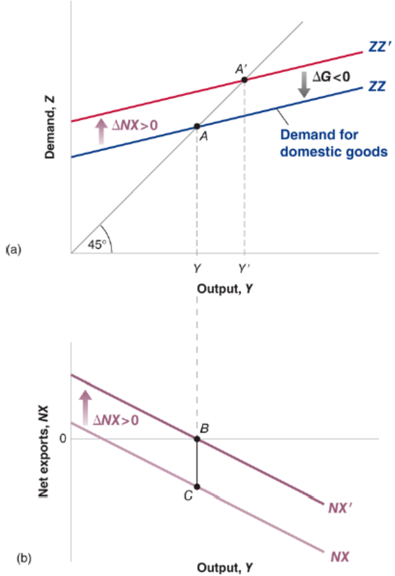
$$\frac{[\varepsilon(\Delta NX)]}{\varepsilon X} = \frac{[(\Delta\varepsilon)X]}{\varepsilon X} + \frac{[\varepsilon(\Delta X)]}{\varepsilon X} - \frac{[\Delta IM]}{\varepsilon X}$$

- If trade is initially balanced ($\varepsilon X = IM$), then:

$$\frac{(\Delta NX)}{X} = \frac{(\Delta\varepsilon)}{\varepsilon} + \frac{(\Delta X)}{X} - \frac{\Delta IM}{IM}$$

Figure 18.5 Reducing the Trade Deficit without Changing Output

To reduce the trade deficit without changing output, the government must both achieve a depreciation and decrease government spending.



18.4 Depreciation, the Trade Balance, and Output (4 of 4)

- If the government wants to eliminate the trade deficit without changing output, it must do two things:
  - achieve a depreciation sufficient to eliminate the trade deficit
  - reduce government spending so as to shift *ZZ* back

Table 18.1 Exchange Rate and Fiscal Policy Combinations

Initial Conditions	Trade Surplus	Trade Deficit
Low output	ε? $G\uparrow$	$\varepsilon\downarrow$ G?
High output	$\varepsilon\uparrow$ G?	ε? $G\downarrow$

18.5 Saving, Investment, and the Current Account Balance (1 of 2)

- Recall Chapter 3 and the income of domestic residents in an open economy (NI: net income from abroad):

$$(Y + NI - T) - C = I + (G - T) + (NX + NI)$$

- Denote the current account by CA ($= NX + NI$), so that the above equation becomes:

$$S = I + (G - T) + CA$$

meaning that the current account balance is equal to saving minus investment:

$$CA = S + (T - G) - I \qquad (6.9)$$

18.5 Saving, Investment, and the Current Account Balance (2 of 2)

- An increase in investment must be reflected either in an increase in private saving or public saving, or in a deterioration of the current account balance.
- A deterioration in the government budget balance must be reflected in an increase in either private saving, or in a decrease in investment, or else in a deterioration of the current account balance.
- A country with a high saving rate must have either a high investment rate or a large current account surplus.

Summary

- In an open economy, an increase in domestic demand leads to a smaller increase in output than in a closed economy as some of the additional demand falls on imports.
- For the same reason, an increase in domestic demand also leads to a deterioration of the trade balance.
- An increase in foreign demand leads, as a result of increased exports, to both an increase in domestic output and an improvement of the trade balance.
- When a group of countries is in a recession, coordination can help their recovery.
- If the Marshall-Lerner condition is satisfied, a real depreciation leads to an improvement in net exports.
- A current account surplus (deficit) corresponds to an excess of saving (investment) over investment (saving).

Output, the Interest Rate, and the Exchange Rate

- In Chapter 18, we treated the **exchange rate** as one of the **policy instruments** available to the government.
- The exchange rate is **not** a policy instrument, but instead it is determined in the **foreign exchange market**.
- In this chapter, we examine the implications of equilibrium in both the goods market and financial markets, including the foreign exchange market.
- The model is an extension to the open economy of the *IS-LM* model and it is known as the **Mundell-Fleming** model.

19.1 Equilibrium in the Goods Market

- Recall the equilibrium condition in Chapter 18:

$$Y = C(\underset{(+)}{Y - T}) + I(\underset{(+,-)}{Y, r}) + G - \frac{IM(Y, \varepsilon)}{\underset{(+,+)}{\varepsilon}} + X(\underset{(+,-)}{Y^*, \varepsilon})$$

which can be rewritten as:[2]

$$Y = C(\underset{(+)}{Y - T}) + I(\underset{(+,-)}{Y, r}) + G + NX(\underset{(-,+,-)}{Y, Y^*, \varepsilon}) \qquad (6.10)$$

- If $\varepsilon = E$,[3] then goods market equilibrium implies that output depends negatively on both the nominal interest rate and the nominal exchange rate:[4]

$$Y = C(\underset{(+)}{Y - T}) + I(\underset{(+,-)}{Y, i}) + G + NX(\underset{(-,+,-)}{Y, Y^*, E}) \qquad (6.11)$$

[2] The Marshall-Lerner condition is assumed to hold.
[3] $P = P^* = 1$ as prices are assumed to be fixed in the short-run.
[4] $\pi^e = 0$, $r = i$.

19.2 Equilibrium in Financial Markets (1 of 2)

- Recall the arbitrage relation or the **interest parity condition** in Chapter 17:

$$E_t = \frac{1 + i_t}{1 + i_t^*} E_{t+1}^e \tag{6.12}$$

- Assume the expected future exchange rate as given ($\bar{E}^e$), so

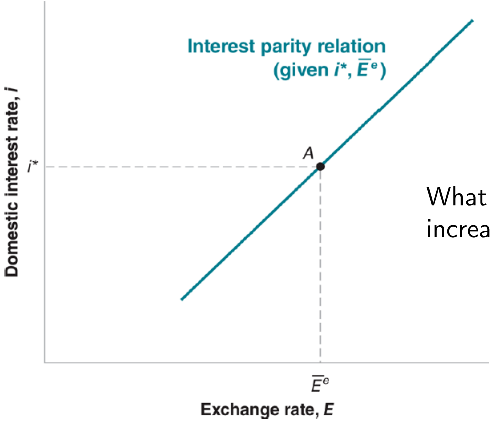
$$E = \frac{1 + i}{1 + i^*} \bar{E}^e \tag{6.13}$$

  which tells us that:
  - An increase in the domestic interest rate leads to an increase in the exchange rate.
  - An increase in the foreign interest rate leads to a decrease in the exchange rate.
  - An increase in the expected future exchange rate leads to an increase in the current exchange rate.

19.2 Equilibrium in Financial Markets (2 of 2)

Figure 19.1 The Relation between the Interest Rate and the Exchange Rate Implied by Interest Parity

A higher domestic interest rate leads to a higher exchange rate – an appreciation.



What happens, if i^* or $\bar{E}^e$ increases?

19.3 Putting Goods and Financial Markets Together (1 of 2)

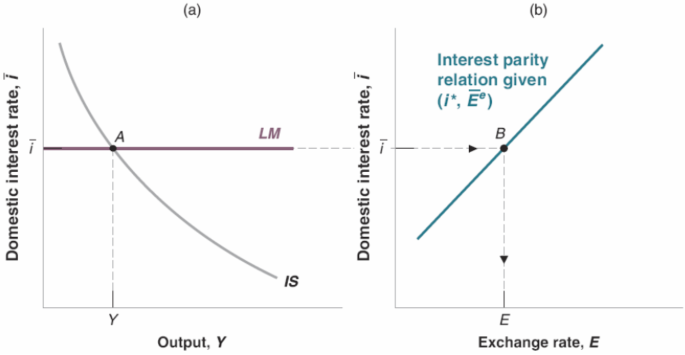
- The **open economy** versions of the familiar *IS* and *LM* relations:

$$IS : Y = C(Y - T) + I(Y, i) + G + NX\left(Y, Y^*, \frac{1+i}{1+i^*}\bar{E}^e\right)$$

$$LM : i = \bar{i}$$

- An increase in the interest rate now has **two effects**:
  - The direct effect on investment
  - The secondary effect through the exchange rate

Figure 19.2 The *IS-LM* Model in an Open Economy

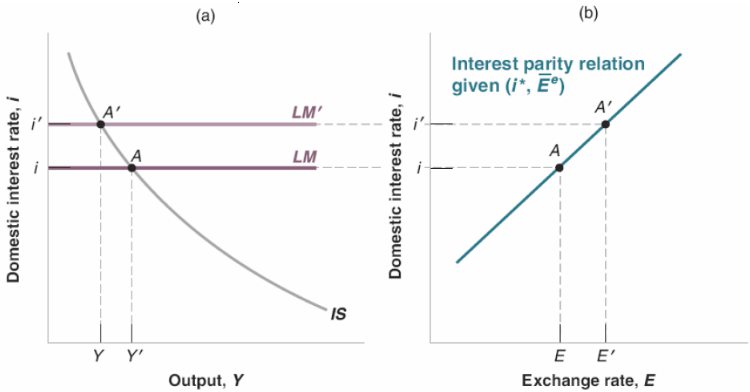


An increase in the interest rate reduces output both directly and indirectly (through the exchange rate). The *IS* curve is downward sloping. The *LM* curve is horizontal, as in Chapter 6.

19.4 The Effects of Policy in an Open Economy (1 of 3)

Figure 19.3 The Effects of an Increase in the Interest Rate

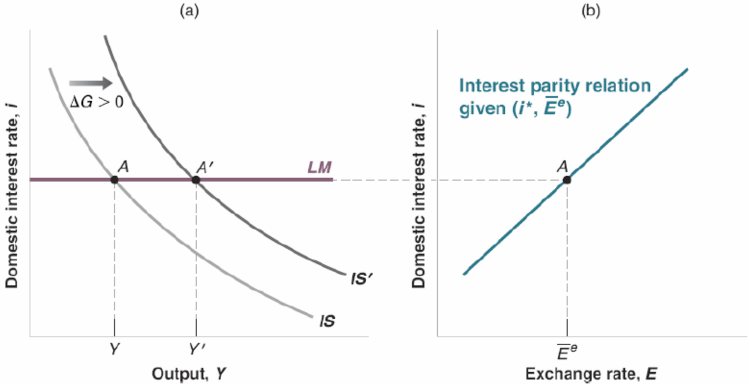
An increase in the interest rate leads to a decrease in output and an appreciation.



What happens, if i^* increases?

Figure 19.4 The Effects of an Increase in Government Spending with an Unchanged Interest Rate

An increase in government spending leads to an increase in output. If the central bank keeps the interest rate unchanged, the exchange rate also remains unchanged.



19.4 The Effects of Policy in an Open Economy (3 of 3)

1. Recall: What happens to the **trade balance** in the scenario presented on the previous slide?

2. What would you expect to happen, if we assume output in point A being equal to **potential output**?

19.5 Fixed Exchange Rates (1 of 2)

- Some countries **peg** their currency to the dollar.
- Some countries operate under a **crawling peg** by moving to an exchange rate target slowly.
- The **European Monetary System** (EMS) determined the movements of exchange rates within the European Union from 1978 and 1998.
- In the EMS, member countries agreed to maintain their exchange rate relative to the other currencies in the system within narrow limits or **bands** around a **central parity** – a given value for the exchange rate.
- Beginning on January 1, 1999, a number of those European countries adopted a common currency, the **euro**.

19.5 Fixed Exchange Rates (2 of 2)

- Recall the interest rate parity condition:

$$(1+i_t) = (1+i_t^*)\left(\frac{E_t}{E_{t+1}^e}\right)$$

- If the country pegs the exchange rate so that $E_t = \bar{E}$, which also is the expectation of the future exchange rate, then the interest rate relation becomes:

$$(1+i_t) = (1+i_t^*) \Rightarrow i_t = i_t^*$$

- *Under a fixed exchange rate and perfect capital mobility, the domestic interest rate must be equal to the foreign interest rate.*
- *Under fixed exchange rates, the central bank gives up monetary policy as a policy instrument (**impossible trinity**).*

Focus: German Reunification, Interest Rates, and the EMS

- German reunification in 1990 led to large increases in demand and interest rates in Germany.
- To stay in the fixed exchange rate regime of the EMS, other European members had to match German interest rates, leading to decreases in their output.

Table 1 Interest Rates, Inflation, and Output Growth after German Reunification: Germany, France, and Belgium, 1990-1992

	Nominal Interest Rates (%)			*Inflation (%)*		
	1990	1991	1992	1990	1991	1992
Germany	8.5	9.2	9.5	2.7	3.7	4.7
France	10.3	9.6	10.3	2.9	3.0	2.4
Belgium	9.6	9.4	9.4	2.9	2.7	2.4
	Real Interest Rates (%)			*GDP Growth (%)*		
	1990	1991	1992	1990	1991	1992
Germany	5.8	5.5	4.8	5.7	4.5	2.1
France	7.4	6.6	7.9	2.5	0.7	1.4
Belgium	6.7	6.7	7.0	3.3	2.1	0.8

The nominal interest rate is the short-term nominal interest rate. The real interest rate is the realized real interest rate over the year – that is, the nominal interest rate minus actual inflation over the year. All rates are annual. *Source:* OECD Economic Outlook.

Summary

- In an open economy, the demand for domestic goods and output depends on both the interest rate and the exchange rate.
- The exchange rate is determined by the interest parity condition, which states that domestic and foreign bonds must have the same expected rate of return in terms of domestic currency.
- Therefore, an increase (decrease) in the domestic interest rate leads to a decrease (increase) in output through two channels:
  - The direct effect on investment
  - The secondary effect through the exchange rate
- Under fixed exchange rates, the central bank gives up independence of monetary policy (more on this in Ch. 20).

Exchange Rate Regimes

- During the Bretton Woods period between 1944 and 1972, a number of countries adopted a **system of fixed exchange rates**, with all member countries other than the United States fixing the price of their currency in terms of dollar.
- Since then, the world has been characterized by many exchange rate arrangements.
- Which exchange rate regime to choose is the issue of this chapter.

20.1 The Medium Run (1 of 4)

- The **real exchange rate** (see Eq. (6.1)) is:

$$\varepsilon = \frac{EP}{P*}$$

which can adjust either:

  - through a change in the nominal exchange rate, E: If the domestic price level and foreign price level do not change in the short run, this is the only way to adjust the real exchange rate in the short run.
  - through a change in the domestic price level relative to the foreign price level: In the medium run, as prices adjust, this option is open even to a country with a fixed nominal exchange rate.

20.1 The Medium Run (2 of 4)

- The *IS* relation in an open economy with **fixed exchange rates**:

$$Y = Y\left(\underset{(-)}{\frac{\bar{E}P}{P^*}}, \underset{(+)}{G}, \underset{(-)}{T}, \underset{(-)}{i^* - \pi^e}, \underset{(+)}{Y^*}\right) \tag{6.14}$$

- Demand and output depend:
  - negatively on the real exchange rate
  - positively on government spending and negatively on taxes
  - negatively on the domestic real interest rate
  - positively on foreign output through the effect on exports

APPENDIX: Deriving the *IS* Relation under Fixed Exchange Rates

- Goods-market equilibrium in Eq. (6.10):

$$Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \varepsilon)$$

- Given the notion of the **real interest rate** (Chapter 6) and the **real exchange rate** (Chapter 17), then under a fixed nominal exchange rate with perfect capital mobility, the domestic interest rate i must be equal to the foreign interest rate i^*, leading to:

$$Y = C(Y - T) + I(Y, i^* - \pi^e) + G + NX\left(Y, Y^*, \frac{\bar{E}P}{P^*}\right)$$

which can be written as Eq. (6.14).

20.1 The Medium Run (3 of 4)

- The **Phillips curve** relation in the medium run (Chapter 9):

$$\pi - \pi^e = (\alpha/L)(Y - Y_n)$$

- Assume constant expected inflation so that:

$$\pi - \bar{\pi} = \left(\frac{\alpha}{L}\right)(Y - Y_n) \tag{6.15}$$

  which implies that, if two economies are operating at potential, inflation rates would be the same, relative prices would remain constant, and so would the real exchange rate.

- In the medium run, if domestic and foreign inflation being equal, the real exchange rate is constant.

20.1 The Medium Run (4 of 4)

- In the short run, a fixed nominal exchange rate implies a fixed real exchange rate.
- In the medium run, the real exchange rate can adjust even if the nominal exchange rate is fixed.
- This adjustment is achieved through movements in the relative price levels over time.

20.2 Exchange Rate Crises under Fixed Exchange Rates (1 of 2)

- To let a currency **float** is to allow a move from a fixed to a flexible exchange rate regime.
- Given the interest rate condition (Chapter 17):

$$i_t = i_t^* - \frac{E_{t+1}^e - E_t}{E_t} \tag{6.16}$$

  which implies that as soon as financial markets believe a devaluation may be coming, maintaining the exchange rate requires an increase in the domestic interest rate.
- Expectations that a devaluation may be coming can trigger an exchange rate crisis.

20.2 Exchange Rate Crises under Fixed Exchange Rates (2 of 2)

- Faced with the expectations of devaluation, the central bank has two options:
  - Give in and devalue, or
  - Fight and maintain the parity, at the cost of high interest rates and a potential recession.

20.3 Exchange Rate Movements under Flexible Exchange Rates (1 of 2)

- Recall the interest parity condition (Chapter 17):

$$(1 + i_t) = (1 + i_t^*) \left(\frac{E_t}{E_{t+1}^e} \right)$$

- Multiply both sides by E_{t+1}^e gives:

$$E_t = \frac{1 + i_t}{1 + i_t^*} E_{t+1}^e \tag{6.17}$$

- Continue to solve forward in time for the expected exchange rate:

$$E_t = \frac{(1 + i_t)(1 + i_{t+1}^e) \dots (1 + i_{t+n}^e)}{(1 + i_t^*)(1 + i_{t+1}^{*e}) \dots (1 + i_{t+n}^{*e})} E_{t+n+1}^e \tag{6.18}$$

20.3 Exchange Rate Movements under Flexible Exchange Rates (2 of 2)

- Implications of Eq. (6.18):
  - The level of today's exchange rate will move one-for-one with the future expected exchange rate.
  - Today's exchange rate will move when future expected interest rates move in either country.
  - Because today's exchange rate moves with any change in expectations, the exchange rate will be **volatile**, i.e., move frequently and perhaps by large amounts.
- A country that decides to operate under flexible exchange rates must accept the fact that it will be exposed to substantial exchange rate fluctuations over time.

20.4 Choosing between Exchange Rates Regimes (1 of 2)

- According to Robert Mundell,[5] an **optimal currency area** needs to satisfy one of the three conditions:
  - The countries have to experience **similar shocks**.
  - Or, if the countries experience different shocks, prices and wages must be very flexible.
  - Or, if the countries experience different shocks, they must have **high factor mobility**.
- The common currency area composed of the 50 states of the United States is close to an optimal currency area, which has high factor mobility, although different states are affected by different shocks.

[5] Mundell, R.A. (1961). A Theory of Optimum Currency Areas. *American Economic Review*, 51(4): 657-665.

Focus: The Euro – A Short History

- Stages moving to a **European Monetary Union** (EMU):
  - Stage I: Beginning in 1990, capital controls were abolished.
  - Stage II: Beginning in 1994, fixed parities of the exchange rate were maintained.
  - Stage III: Beginning in 1999, parities between the currencies and a common currency, the euro, were "irrevocably" fixed; the new **European Central Bank** (ECB) became responsible for monetary policy for the Euro Area.

20.4 Choosing between Exchange Rates Regimes (2 of 2)

- Ways to fix the exchange rate and convince financial investors that the exchange rate is fixed today and also in the future:
  - Make the fixed exchange rate be part of a more general macroeconomic package
  - Make a **hard peg** so that it is symbolically or technically harder to change the parity
- Examples of a hard peg:
  - **Dollarization**: Replace the domestic currency with the dollar
  - **Currency board**: A central bank stands ready to exchange foreign currency for domestic currency at the official exchange rate set by the government

Focus: Lessons from Argentina's Currency Board

- In 1991, Argentina's president announced the adoption of a **currency board** that would stand ready to exchange its pesos for dollars on demand.
- The currency board appeared to work well for a while as inflation fell from 2,300% in 1990 to 4% in 1994.
- However, as an appreciation of the dollar in the second half of the 1990s led to a decrease in demand for Argentina's goods, leading to declines in output.
- In early 2002, Argentina gave up the currency board and let the peso float.

Summary (1 of 2)

- Relation between nominal and real exchange rates under a system of fixed exchange rate:
  - In the short run, a fixed nominal exchange rate implies a fixed real exchange rate.
  - In the medium run, the real exchange rate can adjust even if the nominal exchange rate is fixed.
- Faced with the expectations of devaluation, the central bank has two options:
  - Give in and devalue, or
  - Fight and maintain the parity, at the cost of high interest rates and a potential recession.

Summary (2 of 2)

- A country that decides to operate under flexible exchange rates must accept the fact that it will be exposed to substantial exchange rate fluctuations over time.
- Robert Mundell has suggested conditions for an optimal currency area:
  - similar shocks
  - prices and wages must be very flexible
  - high factor mobility
- Ways to establish a hard peg:
  - Dollarization
  - Currency board